Methodologies for Developing Draft Irrigation, Manufacturing, and Steam-Electric Water Demand Projections

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Texas Water Development Board

1 Summary

After the completion of the 2016 regional water plans, in late 2015, Texas Water Development Board (TWDB) staff determined that water demand projections methodologies for three of the categories – irrigation, manufacturing, and steam-electric power – should be reviewed and perhaps revised to better reflect reported historical water use. In early 2016, CDM Smith was contracted to review the projection methodologies used, provide descriptions of how such projections were developed in other state planning efforts, and recommend alternative methodologies. Throughout 2016, TWDB Water Use Projections & Planning staff discussed potential methodologies for draft water demand projections for irrigation, manufacturing, and steam-electric power with water planning stakeholders.

This document describes the general methodologies to be used in developing the draft irrigation, manufacturing, and steam-electric power water demand projections to be included in the 2021 regional water plans and the 2022 State Water Plan. Summaries of the methodologies are included below with more complete descriptions and examples in subsequent sections.

1.1 Irrigation water demand projection methodology summary

The baseline methodology for draft irrigation water demand projections is the average of the most recent five-years of water use estimates held constant between 2020 and 2070. In counties where the total groundwater availability over the planning period is projected to be less than the groundwater-portion of the baseline water demand projections, the irrigation water demand projections will begin to decline in 2030 or later, commensurate with the groundwater availability.

1.2 Manufacturing water demand projection methodology summary

The 2020 water demand projections for each county will be based on the highest county-aggregated manufacturing water use in the most recent five years of reported data from the annual water use survey. The most recent 10-year projections for employment growth from the Texas Workforce Commission will be used as proxy for growth by manufacturing sectors between 2020 and 2030. After 2030, the manufacturing water use will be held constant through 2070.

1.3 Steam-electric power water demand projection methodology summary

The 2020 water demand projections for each county will be based on the highest county-aggregated steam-electric power water use in the most recent five years of reported data from the annual water use survey. The anticipated water use of future facilities listed in state and federal reports will be added to the demand projections from the anticipated operation date to 2070. In addition, the reported water use of facilities scheduled for retirement in the state and federal reports will be subtracted from the demand projections.

Subsequent demand projections after 2020 will be held constant throughout the planning period.

2 Irrigation water demand projections

Irrigation water use accounts for 58 percent of the 2014 water use estimates and in the current state water plan, is projected to be 51 percent of the 2020 total water demand projections, while declining to 36 percent in 2070. Aside from small adjustments to water demand projections based on recent historical water use estimates, there has not been a statewide re-projection of irrigation water demand projections, and many areas of the state have not had any significant change in projected trend lines since the 1997 State Water Plan. Due to the scale of irrigation in current water use and future water demands, as well as the outdated statewide projections, TWDB staff will utilize the following methodology for developing draft irrigation water demand projections for the planning cycle cumulating in the 2021 regional water plans and the 2022 State Water Plan.

The methodology described below will produce draft water demand projections that will be reviewed by the Regional Water Planning Groups (RWPGs). The criteria for requesting changes to the draft projections will be described in the TWDB regional water planning contract, Exhibit C: General Guidelines for Fifth Cycle of Regional Water Plan Development.

2.1 Baseline default projection methodology

Future water demands for irrigation purposes are significantly impacted by commodity prices, production costs, federal agricultural policies, and federal energy policies. Any attempt to forecast such factors and their impact on water use over a 50-year period would be impractical. A more credible methodology is to focus on recent historical irrigation water use data as an indicator of future use. Therefore, the default baseline dry-year irrigation demand projection for most areas will be the average of the annual irrigation water use estimates over the most recent five years of water use data and that average volume will then be held constant over the planning period.

In previous water plans, the volumes of reuse water, such as treated effluent, used by irrigated agriculture have not been included in the historical water use estimates or the water demand projections. However, because the RWPGs are increasingly including reuse water as an available supply and viewing reuse as an important part of meeting future water demands, the draft projections for the 2021 regional water plans and the 2022 State Water Plan will be developed to include the reuse volumes used for irrigated agriculture, as reported by water utilities or groundwater conservation districts. The 2014 estimated volume of reuse water was 56,621 acre-feet, or less than one percent of the 2014 freshwater irrigation water use.

2.2 Projection methodology for areas with significant groundwater availability declines

Much of projected irrigation demands of the state are supplied by groundwater sources that are projected to decline significantly over 50 years, which has resulted in large volumes of water needs and unmet water needs in the regional and state water plans. In

the 2017 State Water Plan, irrigation water needs accounted for 41 percent of the total water needs in 2070 and accounted for 90 percent of the total water needs that were left unmet. Three quarters of such unmet irrigation needs are in counties whose irrigators primarily utilize groundwater (75 percent or more of existing sources are groundwater sources). Such figures indicate that in areas with declining groundwater availability, the options of irrigators to fund feasible water management strategies beyond conservation are limited.[1] For these reasons, the draft irrigation water demand projections in some locations will take into account significant groundwater availability declines.

While constraining water demand projections based on water resource availability would most likely occur in areas primarily utilizing groundwater, such constraints could also occur in areas with limitations of surface water rights or contracts. At this stage however, TWDB does not have sufficient information to attempt to constrain surface water demands and will defer to RWPGs to identify such instances, if appropriate.

The general determination as to whether irrigation water demand projections should be constrained by groundwater water resource availability will be as follows:

A) If the groundwater-supplied portion of the baseline irrigation demand projections, summed over the 50 year planning horizon, is less than the total groundwater availability of the county (based on the 2017 State Water Plan, a new modeled available groundwater (MAG) volume, or predictive pumping from a proposed desired future condition (DFC)), whichever is the most recent) summed over the 50 year planning period then the baseline irrigation water demand projections will not be modified to reflect declining groundwater availability.

B) If the groundwater-supplied portion of the baseline irrigation demand projections, summed over the 50 year planning horizon, is greater than the total groundwater availability of the county (based on the 2017 State Water Plan, a new MAG volume, or predictive pumping from a proposed DFC) summed over the 50 year planning period then the baseline irrigation water demand projections will be modified to reflect declining groundwater availability.

This is a relatively conservative approach to constraining water demands, in that it is based on the full groundwater availability within each county regardless of other groundwater uses in the same county.

[1] The 2006 Region A Water Plan referred to such observations in a Region A 2003 region-specific study regarding agricultural demand projections: "Documented declines in the Ogallala Aquifer suggest long-term water use in the region will fall due to availability. In the Region A Senate Bill 1 effort, it was demonstrated that irrigated crop use per unit of water pumped had by far the lowest return compared to the other sectors. Therefore, any projected declines in water use due to limited availability are expected to occur in this sector. Furthermore, any anticipated increases in water use by the other sectors, for example, livestock, are expected to come at the expense of irrigation." 2006 Region A Water Plan, Appendix N, page 18. http://www.twdb.texas.gov/waterplanning/rwp/plans/2006/A/Region_A_2006_RWP.pdf

2.2.1 Constrained water demand projections

If the baseline irrigation water demand projections associated with groundwater and summed over 50 years, exceeds the projected groundwater resource (groundwater availability or predictive pumping) summed over 50 years, then the water demand projections will reflect groundwater availability constraints as described below.

Starting at the year 2020 baseline projection, the demand volume will be held constant for at least one decade. If the annual groundwater availability is lower than the baseline projection at the beginning of the planning period (2020), then beginning in 2030, the subsequent demands will parallel the trend of the groundwater availability (MAG or predictive pumping volumes of proposed or new DFCs). See Example 1, Figure 2.1. If the annual groundwater availability equals or exceeds the default baseline annual groundwater projection (5-year water use average) at the beginning of the planning period (2020) but then falls below the baseline projection at a later point, then the irrigation water demand projections will not begin to parallel the groundwater availability until 10 years after the point at which groundwater availability has fallen below the baseline demand projections. See Example 2, Figure 2.2. This approach acknowledges:

- recent actual pumping and associated irrigation demands; and
- residual irrigation water demands that are anticipated to remain above available groundwater supplies for some period but are then anticipated to decline over time in response to persistent declining groundwater availability.

This will produce demand projections that are a constant volume above the reference groundwater availability volumes. This buffer over the groundwater availability is intended to address a number of unknowns:

- the differences between pumping values used in groundwater models and TWDB historical irrigation water use estimates,
- the variations between wet-year and dry-year pumping, and
- the scale of irrigation water needs in groundwater resource-constrained areas that can be met through recommending conservation water management strategies. See Example 1 and Figure 2.1.

The portion of the baseline irrigation water demand projection anticipated to be supplied by surface water based on recent water use data will not be constrained in these instances.

In order to address changes in irrigated agriculture and any changes in water-use patterns, the draft irrigation water demands will be developed with each planning cycle. As with any methodology applied statewide, there may be specific cases for which this general methodology is not appropriate. In such cases, TWDB staff will adjust the methodology as necessary while being consistent with the original intent.

2.3 Examples of Draft Water Demand Projections

2.3.1 Example 1 – Draft irrigation water demand projections constrained by groundwater resources

The first example of the draft irrigation water demand projections, illustrated in Figure 2.1, is of a county whose irrigation is supplied entirely by groundwater. The average water use from the most recent 5 years is 310,379 acre-feet. The baseline irrigation water demand projections for the county would be 310,379 acre-feet of water each year throughout the planning period.

The sum of the annual default water demand projections over the planning period (15.8 million acre-feet) is greater than the summed annual predictive pumping volumes for the associated aquifers that are the result of the groundwater management area's (GMA) proposed, but not yet adopted, DFCs (4.2 million acre-feet), so the irrigation water demand projections will be modified to reflect groundwater availability constraints. As the 2020 baseline projection (310,379 acre-feet) is greater than the 2020 simulated pumping (218,397 acre-feet), the constrained demand projection will start at the 2020 baseline, hold constant for one decade, and then decline commensurate with the groundwater availability declines while remaining above the groundwater availability. The groundwater-constrained irrigation demand (triangles in Figure 2.1) declines from 301,379 acre-feet in 2030 to 228,218 acre-feet in 2070.

If the county's irrigation was also supplied by surface water, then a baseline surface water demand projection (5-year average of historical water use) for the surface water would be added to the groundwater-constrained demand projection.

2.3.2 Example 2 – Draft irrigation water demand projections constrained after 2020 by groundwater resources

The second example of the draft irrigation water demand projections, illustrated in Figure 2.2, is similar to Example 1. Like the previous example, all irrigation is entirely supplied by groundwater. The 50-year sum of the annual baseline water demand projections (6.6 million acre-feet) is greater than the summed annual groundwater availability: predictive pumping volumes for the primary aquifers resulting from the GMA's proposed, but not yet adopted, DFCs (3.8 million acre-feet). For this reason, the irrigation water demand projections will reflect groundwater availability constraints. However, in this example, the 2020 predictive pumping (160,976 acre-feet) would still be greater than the baseline water demand projections based on the 5-year historical water use estimates (128,837 acre-feet), so the baseline water demand projection will be held constant until 2035 - 10 years after the point when the groundwater availability falls below the baseline demand (2025). In 2035, and throughout the rest of the planning horizon, the irrigation water demand projections will decline commensurate with the groundwater availability decline, while remaining well above the groundwater availability.

As in Example 1, if the county's irrigation was also supplied by surface water, then a baseline water demand projection (5-year average of historical water use) for the surface water would be added to the groundwater-constrained demand projection.

Figure 2.1. Potential Draft Irrigation Water Demand Projections: Declining Groundwater Example (acre-feet of water per year)

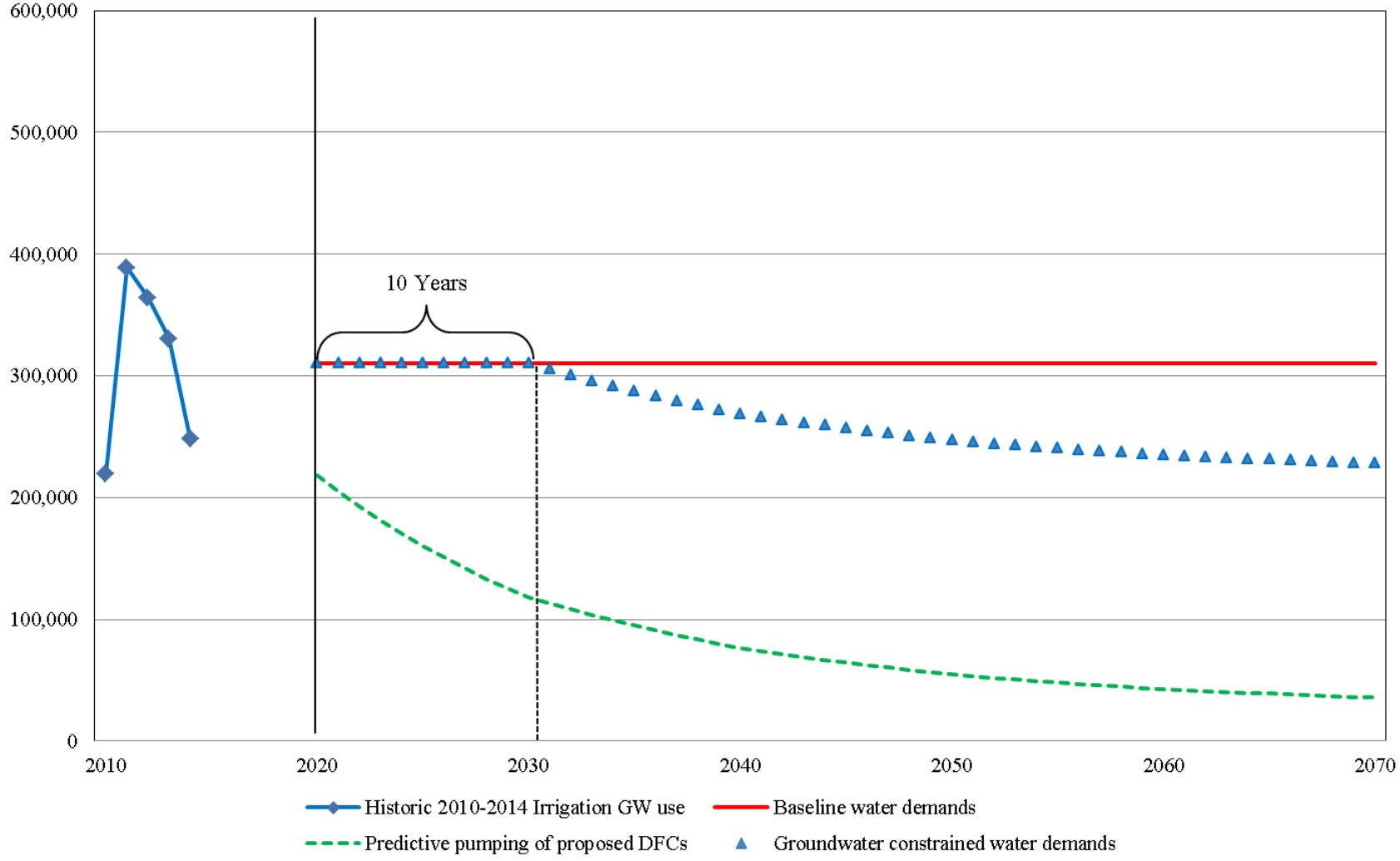
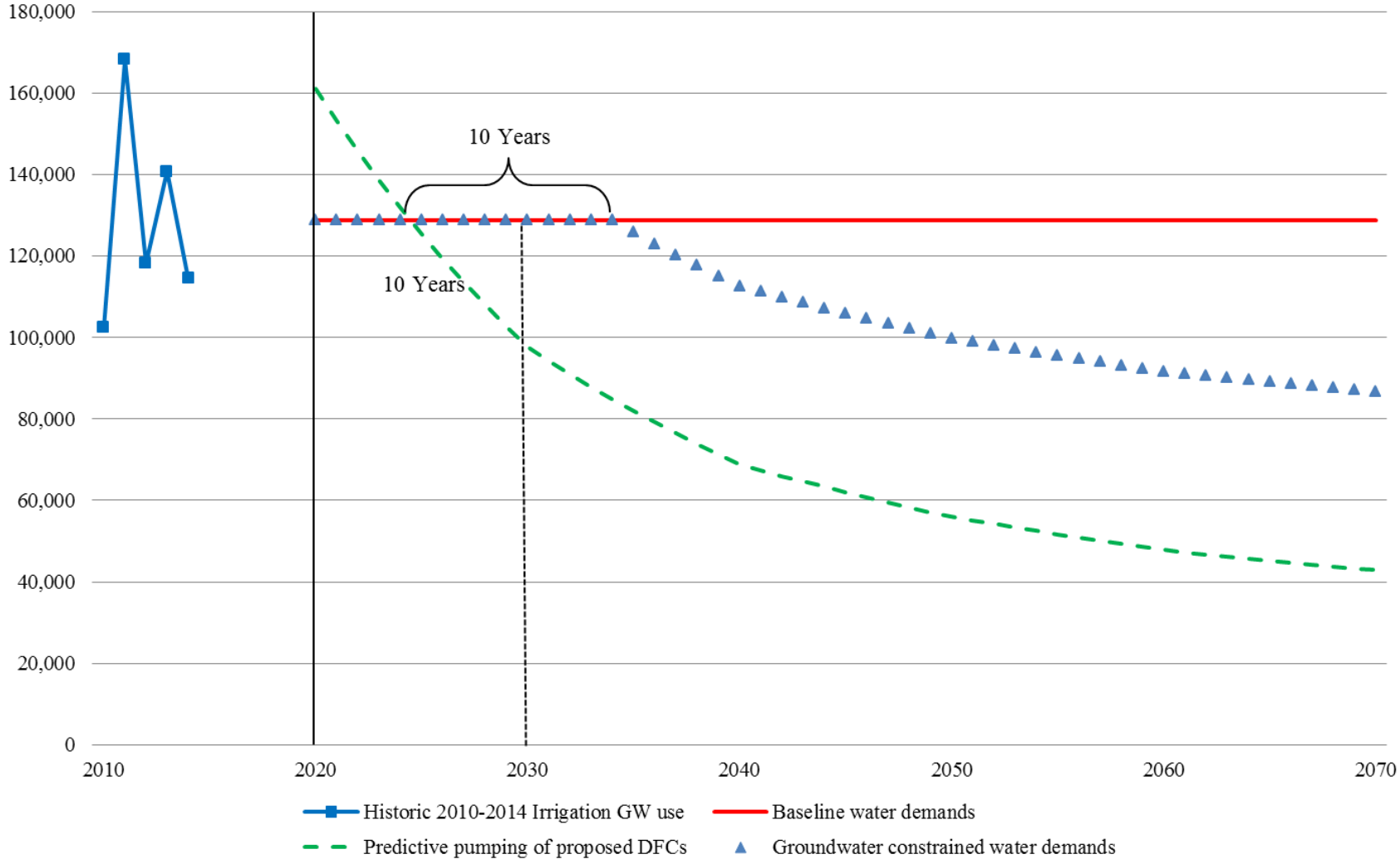


Figure 2.2. Potential Draft Irrigation Water Demand Projection: Declining Groundwater Example (acre-feet of water per year)



3 Manufacturing water demand projections

Historically, manufacturing water demands have been based upon projected levels of produced goods or economic output for individual manufacturing sectors. Unfortunately, historical and projected production data are often proprietary and not readily available. Projections of economic output often utilize complex econometric models based upon a variety of inputs such as population, sales, inflation, interest rates, oil prices and other factors.

It is important to note that the manufacturing water use category does not include the water use of all firms that might be classified as manufacturing under the North American Industrial Classification System (NAICS). In collecting manufacturing water use data, Texas Water Development Board (TWDB) staff focuses on facilities that use large volumes of water, relative to the area of the state and/or are self-supplied by groundwater or surface water. Consequently, the water demand projections in the regional and state water plans are focused on these large manufacturing water users. The smaller-use facilities that are not part of the water use survey are generally supplied by public utilities as commercial accounts, and thus, part of the municipal water demands.

The methodology described below will produce draft water demand projections that will be reviewed by the Regional Water Planning Groups (RWPGs). The criteria for requesting changes to the draft projections will be described in the TWDB regional water planning contract, Exhibit C: General Guidelines for Fifth Cycle of Regional Water Plan Development.

3.1 Baseline projection methodology

The draft 2020 manufacturing water demand projections will be based upon the highest county manufacturing water use in the most recent five years of county-aggregated data for manufacturing water users from the annual water use survey. The highest reported facility water use volumes will be subtotaled by county and three-digit NAICS categories. As part of the process, TWDB staff will conduct additional reviews of Texas Commission on Environmental Quality industrial water right usage reports and will contact wholesale water providers and groundwater conservation districts who are not otherwise surveyed to ensure that all large-water use manufacturing facilities are included in the historical estimates.

In previous water plans, the volumes of reuse water, such as treated effluent, used by manufacturing facilities have not been included in the historical water use estimates or the water demand projections. However, because the RWPGs are increasingly including reuse water as an available supply and viewing reuse as an important part of meeting future water demands, particularly industrial demands, the draft projections for the 2021 regional water plans and the 2022 State Water Plan will be developed to include the reuse volumes reported by the manufacturing facilities. The 2009-2014 average volume of reuse water reported statewide by surveyed manufacturing facilities was 21,904 acre-feet, or two percent, of the total average freshwater manufacturing water use in that same period. Similarly, any brackish or saline water use that had been omitted from water use estimates

and projections will be included in the draft projections. This does not include seawater use.

To project the draft manufacturing water demands beyond 2020, staff will utilize the most recent 10-year projections of employment from the Texas Workforce Commission (TWC) by 3-digit NAICS categories and the 28 Workforce Development Areas (WDAs) in the state[2]. The projection of employment from the TWC will be used as a proxy for growth in output and water use in a particular industrial sector and county of the state. The employment growth rate will be applied to the 2020 water demand projection (highest county use in the last five years), to develop a 10-year projection of water demand.

In cases where the employment is projected to decrease for a 3-digit NAICS sector, the water demand projection will be held constant rather than decline. This is a conservative approach that assumes that any water designated for manufacturing, whether through surface water rights, groundwater rights, or water sales from water providers will likely be utilized by other manufacturing firms.

Beyond 2030, the water demand will be held constant through 2070. Concerns were expressed during methodology development about the impression of manufacturing water use indicating that manufacturing is not thriving. TWDB staff has determined that holding manufacturing water use constant between 2030 and 2070 is the most efficient, effective, and reasonable strategy for developing draft water demand projections and planning for future manufacturing water use for the following reasons:

1) Basing projections on the highest county water use of the most recent five years of data ensures that we will be planning for water use that has already occurred in the recent past.
2) The long-term trend of manufacturing water use in Texas and in the nation has been decreasing while output has been increasing.[3] Within Texas, the statewide manufacturing water use has shown a statistically significant downward trend between 2005 and 2014. Manufacturing facilities in the state have become more and more efficient with water over the last decade, as stated by the Texas Association of Manufacturers and the Texas Oil & Gas Association.[4] Staff expects manufacturing firms to continue to increase their efficient use of water in the various processes.
3) The development of modeled projections would be complicated, expensive, and leave room for a significant amount of error due to the large range of manufacturing activities, the cost of acquiring proprietary projections of various economic outputs, and the speed at which industries shift and process technology changes.
4) While the historical trend for manufacturing water use appears to be decreasing, staff believe that to project water demands at a recent historical level, while

[2] http://www.tracer2.com/?PAGEID=67&SUBID=114
[3] Hoffman, H.W. (Bill), "Manufacturing and Electric Power Water Use in Texas, submitted to the Water Conservation Advisory Council,
http://www.savetexaswater.org/resources/doc/Hoffman_Manufacturing_2016.pdf
[4] Letters submitted to the Water Conservation Advisory Council for the August 1, 2016 meeting.
http://www.savetexaswater.org/meeting/council-meetings.asp

updating the projections in each planning cycle, is a conservative and reasonable approach to ensure that sufficient water is planned for manufacturing use.

In order to address changes in the manufacturing sectors and any changes in water-use patterns, the draft manufacturing water demands will be developed with each planning cycle. As with any methodology applied statewide, there may be specific cases for which this general methodology is not appropriate. In such cases, TWDB staff will adjust the methodology as necessary while being consistent with the original intent.

3.2 Example of baseline draft projection methodology

An example of the proposed methodology for draft manufacturing water demands focuses on Travis County and is described below. The historical manufacturing water use in Travis County is displayed in Table 3.1. Manufacturing facilities in nine 3-digit NAICS classification have been surveyed through the TWDB's annual water use survey. The highest annual county water use for the manufacturing water users in Travis County between 2010 and 2014 is 9,781 acre-feet.

Table 3.1. Historical manufacturing water use by 3-digit NAICS, Travis County, TWDB water use survey

NAICS 3-Digit Code		Net Use Summary from Water Use Survey (acre-feet per year)					
No.	Name	2010	2011	2012	2013	2014	Highest County Use (2013)
311	Food	101	101	185	402	279	402
312	Beverage and Tobacco Product	180	117	103	103	101	103
322	Paper	31	0	0	0	0	0
325	Chemical	755	678	687	739	738	739
327	Nonmetallic Mineral Product	262	258	239	236	304	236
333	Machinery	224	279	178	132	136	132
334	Computer and Electronic Product	6,016	6,843	7,991	8,163	7,640	8,163
335	Electronic Equipment, Appliance, and Component	5	0	0	0	0	0
339	Miscellaneous	7	11	6	6	6	6
	Total	7,581	8,287	9,389	9,781	9,204	9,781

The projected employment by 3-digit NAICS categories for the Capital Area WDA (Travis County only in this case) is shown in Table 3.2. Overall, the employment in the manufacturing categories are projected to grow from 32,810 to 38,020 jobs, an increase of approximately 16 percent, however the growth rate within each 3-digit NAICS category differs.

To calculate the projected manufacturing water demand, the average water use for each NAICS category is multiplied by the employment growth rate. As all NAICS sectors are projected to have population growth, no categorical water use was held constant. The calculation results in a projected manufacturing water demand of 9,781 acre-feet in 2020 and 11,348 acre-feet in 2030 (Table 3.3). Table 3.4 provides a comparison of the results of the methodology example for Travis County with the previous projections used in the 2017 State Water Plan. The resulting projection for manufacturing in Travis County is significantly lower due to the predominantly downward historical trend in the estimated water use of manufacturing facilities in the county, from a high of 22,168 acre-feet in 1998 to 9,204 acre-feet in 2014.

Table 3.2. Texas Workforce Commission projected employment by 3-digit NAICS, Travis County

NAICS 3-Digit Code		TWC Employment		
No.	**Manufacturing Category Name**	**2012**	**2022**	**10-Year Growth Rate**
311	Food	1,570	1,860	18.5%
312	Beverage and Tobacco Product	510	800	56.9%
322	Paper	10	10	0.0%
325	Chemical	1,830	1,920	4.9%
327	Nonmetallic Mineral Product	940	1,060	12.8%
333	Machinery	2,360	2,450	3.8%
334	Computer and Electronic Products	22,530	26,290	16.7%
335	Electronic and Equipment , Appliance, and Component	780	1,030	32.1%
339	Miscellaneous	2,280	2,600	14.0%
	Total	**32,810**	**38,020**	15.9%

Table 3.3. Example of draft manufacturing water demand projection, Travis County

NAICS 3-Digit Code		Water Volume (acre-feet per year)	
No.	Name	2020 Water Demand (Highest County Use)	2030 Water Demand
311	Food	402	476
312	Beverage and Tobacco Product	103	162
322	Paper	0	0
325	Chemical	739	775
327	Nonmetallic Mineral Product	236	266
333	Machinery	132	137
334	Computer and Electronic Product	8,163	9,525
335	Electronic Equipment, Appliance, and Component	0	0
339	Miscellaneous	6	7
	Total	9,781	**11,348**

Table 3.4. Comparison of projected manufacturing water demand projections by decade, Travis County (acre-feet per year)

Projection	2020	2030	2040	2050	2060	2070
Example Draft for 2021 Regional Water Plan	9,781	11,348	11,348	11,348	11,348	11,348
2017 State Water Plan	35,790	48,710	63,858	72,991	81,781	91,630

4 Steam-electric water demand projections

The water use for steam-electric power generation is influenced by a number of factors, including electricity demand, fuel prices, weather conditions, the cooling design of the facilities, and others. Historically, studies have attempted to calculate future water use of power generation by estimating future scenarios of the various factors over 50 years and then developed a most-likely calculated water use volume as a result of the contributing factors.

As part of each planning cycle, the draft steam-electric power water demand projections for each county will be developed based upon:

1) The highest county water use in the most recent five years of data for steam-electric power water users from the annual water use survey,
2) Near-term additions and retirements of generating facilities, and
3) A constant water demand volume through 2070.

The methodology described below will produce draft water demand projections that will be reviewed by the Regional Water Planning Groups (RWPGs). The proposed criteria for requesting changes to the draft projections will be described in the Texas Water

Development Board (TWDB) regional water planning contract, Exhibit C: General Guidelines for Fifth Cycle of Regional Water Plan Development.

4.1 Projection methodology for draft water demand projections

4.1.1 Historical steam-electric power water use

The TWDB annually surveys the power-generating facilities in the state to estimate the volume of water used for steam-electric power. The water use volumes posted on the TWDB website and used in the water planning process includes volumes used by large power generation plants that sell power on the open market, generally not cogeneration plants that generate power for manufacturing or mining processes. Specifically, the water use estimates are composed of the reported intake volume of groundwater pumped, purchased from a water provider, and/or withdrawn from a natural surface water source (such a river) and not returned to the source. The volume of any sales of water from the surveyed facility to other facilities or water systems is subtracted from the intake volume.

In previous water plans, the volumes of reuse water, such as treated effluent, used by generating facilities have not been included in the historical water use estimates or the water demand projections. However, because the RWPGs are increasingly including reuse water as an available supply and viewing reuse as an important part of meeting future water demands, the draft projections for the 2021 regional water plans and the 2022 State Water Plan will be developed to include the relevant reuse volumes reported by the steam-electric power facilities. The 2009-2014 average volume of reuse water reported statewide by surveyed power facilities was 31,009 acre-feet, or approximately 6 percent, of the total freshwater steam-electric power water use. Similarly, any brackish or saline water use that had been omitted from water use estimates and projections will be included in the draft projections. This does not include seawater use.

If any known power generation facility has been missed in the TWDB's annual water use survey, then that facility's water use will be obtained from the operator or estimated using average water use per kilowatt-hour output for the associated fuel-type and added to the historical highest water use for that county.

4.1.2 Near-term (2020) draft projection methodology

In addition to the historical highest county water use in the most recent five years of data, staff will identify new power plants that will come online and plants that will retire in the near-term future using the most recent Electric Reliability Council of Texas (ERCOT) Capacity, Demand, and Reserves (CDR) report[5] and the U.S. Energy Information Administration's (EIA) EIA-860 generator database. Information from power-generation representatives in the RWPGs and other stakeholders may also be utilized.

For near-term facilities identified in the reports or from other sources, staff will estimate the anticipated annual water use for future plants based upon their fuel type, generation

[5]http://www.ercot.com/gridinfo/resource

capacity, average water use information and average operational time. The average water use per kilowatt hour will be based on water demand factors presented in the contracted "Evaluation of Water Projection Methodologies & Options for Agency Consideration" (Table 4.1).[6] The average percentage of operation time for near-term future facilities will be based upon the historical equivalent forced outage rates received from ERCOT (Table 4.2).[7] Historical water use for facilities that are listed in the CDR report for retirement in the near-term, and for which there is not anticipated replacement generation capacity, will be removed from future projections.

Table 4.1. Water use factors by fuel type in Texas, 2010[8]

Fuel type[a]	Facility Count	Net Generation (TWh[b])	Volume Consumed (kaf[c])	Gallons per KWh[d]
Coal	38	150.7	248.4	0.53
Natural Gas	65	109.3	94.7	0.28
Nuclear	4	41.3	59	0.46

[a]Includes steam turbine and combined cycle generator technology and once-through and tower cooling systems. Cogeneration is not included in this analysis.

[b]Terawatt hour

[c]Thousand acre-feet of water

[d]Kilowatt hour

Table 4.2. Average percentage of operation time for near-term future facilities

Fuel and Generation Types	Average Percentage of Operation Time
Coal Steam Turbine	70%
Natural Gas Combined Cycle	59%
Natural Gas Steam Turbine	14%
Natural Gas Turbine	7%
Nuclear	85%

4.1.3 Long-term (2020 - 2070) draft projection methodology

The 2020 steam-electric power water demand projection will include the highest county water use in the most recent five years of data plus the anticipated water use of new facilities and the subtraction of retiring facilities, as described above. Beyond 2020, the draft water demand projections are held constant through 2070. Such constant projections are efficient, effective, and reasonable for the following reasons:

1) Basing projections on the highest county water use of the most recent five years of data ensures that we will be planning for water use that has already occurred in the recent past.

[6] "Evaluation of Water Projection Methodologies & Options for Agency Consideration", CDM Smith, TWDB Contract 1600011921, Table 4-7, page 4-20

[7] Email correspondence with ERCOT staff member, Pete Warnken, September 19, 2016.

[8] Evaluation of Water Demand Projection Methodologies & Options for Agency Consideration, CDM Smith in conjunction with the University of Texas, Bureau of Economic Geology, 2016, page 4-20, Table 4-7.

2) To model a projection of steam-electric power water use would require the inclusion of a multitude of potential water-use drivers – each with an individual probability of occurring and level of impact – including, but not limited to: the facility replacement schedule, anticipation of generation efficiency and cooling systems, carbon capture activities, cost of various fuels and federal environmental/regulatory policies. Such an effort is resource-prohibitive.
3) The projected increase of wind and solar generation capacity which off-set the necessity to run water-consuming facilities and may meet a significant portion of the additional water demand in the future.
4) While water-consuming coal, oil, and natural gas facilities will be required in the future, any such plants replacing an older plant will be more water efficient, either using less water or producing more power with a similar volume of water that had already been acquired at the site.
5) Any assumed increase between 2020 and 2070 would require a distribution of such additional water use to the county level. Based on discussions with power generating company contacts, this is a difficult exercise, as the locations of new facilities not listed in governmental reports cannot be identified. To distribute anticipated additional water use to counties with existing facilities will result in over-projections in most counties and under-projection in others. Any specific new facility brought forward by the RWPGs will result in the double-counting of water use to meet anticipated electrical demand, as the assumed increase had already been distributed statewide.
6) The steam-electric power water demand projections will be updated with each planning cycle with the most recent data.

In order to address changes in the power generation industry and any changes in water-use patterns, the draft steam-electric power water demands will be developed with each planning cycle. As with any methodology applied statewide, there may be specific cases for which this general methodology is not appropriate. In such cases, TWDB staff will adjust the methodology as necessary while being consistent with the original intent.

4.2 Example of baseline projection methodology

An example of the proposed steam-electric power draft water demand methodology is shown for Hood County. Currently, the county has two power-generation facilities that report water use information through the TWDB's annual water use survey (Table 4.3). Neither facility has reported the use of treated effluent in their cooling processes.

Table 4.3. Historical steam-electric power water use, Hood County, TWDB water use survey

Facility Name	Water Use (acre-feet per year)					
	2010	**2011**	**2012**	**2013**	**2014**	**Highest Use**
Luminant Generation Company LLC-DeCordova Steam Electric Station	491	449	571	514	742	742
Wolf Hollow 1 Power LLC[1]	2,441	2,232	2,838	2,555	3,131	3,131
Total	**2,932**	**2,681**	**3,409**	**3,069**	**3,873**	**3,873**

[1]The Wolf Hollow 1 generation facility first reported in the 2012 TWDB annual water use survey. ***For this example***, the 2009 – 2012 water use estimates were developed based on the 2013 reported water use and being adjusted similar to the variation of the annual use of the Luminant generation facility.

For this example, a fictional natural-gas fueled combined cycle generation facility in Hood County with a capacity of 1,077 MWh will be assumed to be listed in the most recent ERCOT CDR report. Based on average water use information of similar generation facilities in Texas, the new facility would consume 0.28 gallons per KWh (Table 4.1). Utilizing the average percentage of operation time for such a facility (Table 4.2), the new facility will use 4,783 acre-feet of water per year.

The 2020 projected steam-electric water demands for Hood County would be composed of the highest water use in the last five years of data (3,873 acre-feet) and the anticipated use of the new facility (4,783 acre-feet), for a total of 8,656 acre-feet.

Table 4.4. Draft steam-electric water demand projections by decade and 2017 State Water Plan steam-electric water demand projections, Hood County (acre-feet per year)

Projection	2020	2030	2040	2050	2060	2070
Projected historical use	*3,873*	*3,873*	*3,873*	*3,873*	*3,873*	*3,873*
New facility use	*4,783*	*4,783*	*4,783*	*4,783*	*4,783*	*4,783*
Example Draft for 2021 Regional Water Plan	**8,656**	**8,656**	**8,656**	**8,656**	**8,656**	**8,656**
2017 State Water Plan	5,814	6,796	7,995	9,456	11,238	13,354