2016 Region C Water Plan

Volume I

Main Report

December 2015

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2016 Region C Water Plan

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2016 REGION C WATER PLAN

DECEMBER 2015

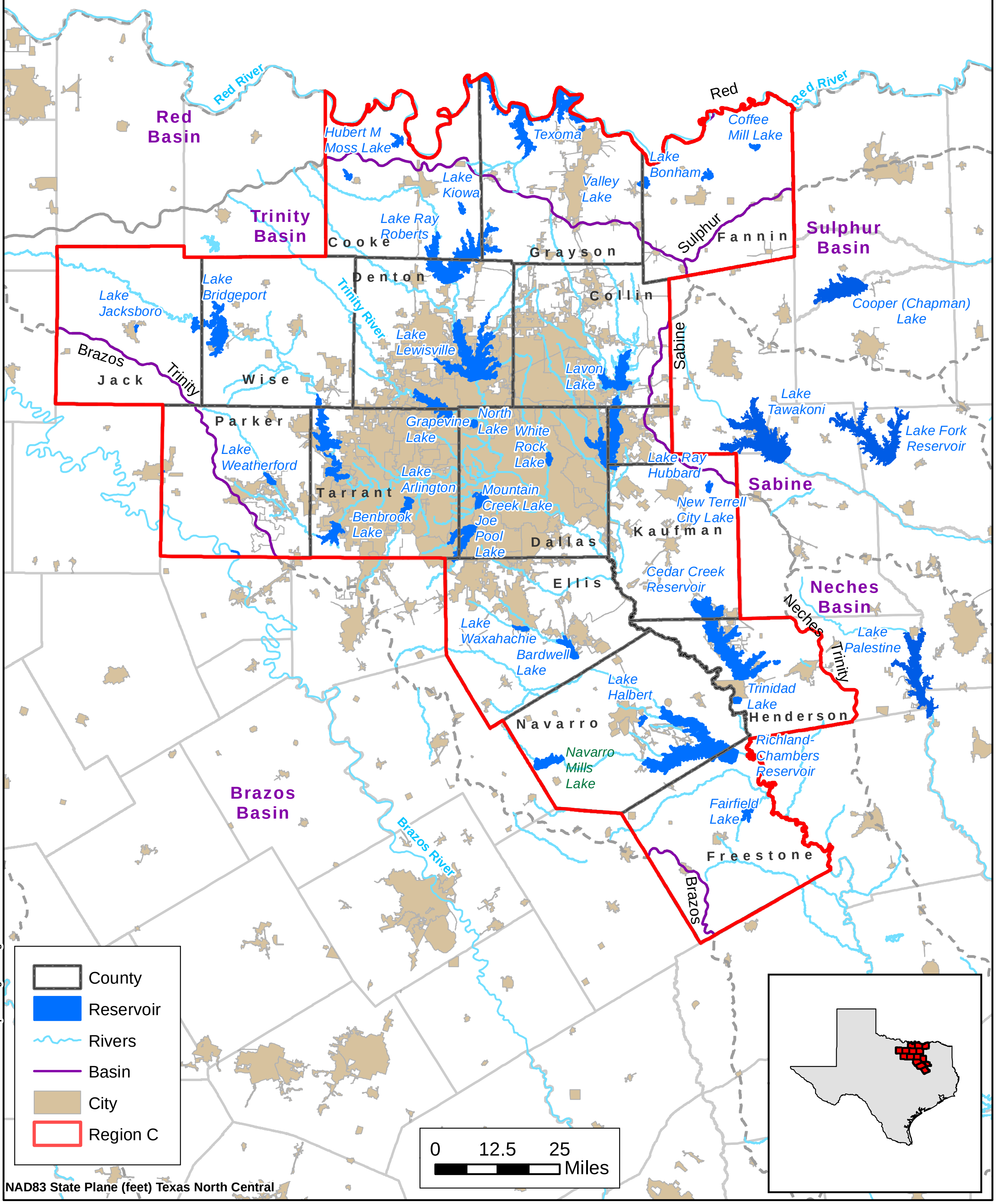
Executive Summary

This report presents the *2016 Region C Water Plan* developed in the fourth round of the Senate Bill One regional water planning process. Region C covers all or part of 16 North Central Texas counties, as shown in Figure ES.1. The Region C water plan was developed under the direction of the 22-member Region C Water Planning Group. An initially prepared regional water plan was adopted by the Region C Water Planning Group on April 20, 2015 and was made available for public and state agency comment during the summer of 2015. This final *2016 Region C Water Plan* was produced based on the initially prepared plan, comments, and other updates, and this final plan was approved by the Region C Water Planning Group on November 9, 2015.

The *2016 Region C Water Plan* includes the following chapters:

1. Description of Region C
2. Population and Water Demand Projections
3. Analysis of Water Supply Currently Available to Region C
4. Identification of Water Needs
5. Identification, Evaluation and Selection of Water Management Strategies
    - 5A. Methodology for Evaluation and Selection of Water Management Strategies
    - 5B. Evaluation of Major Water Management Strategies
    - 5C. Recommended Water Management Strategies for Wholesale Water Providers
    - 5D. Recommended Water Management Strategies for Water User Groups by County
    - 5E. Water Conservation and Reuse
    - 5F. Texas Water Development Board Required Tables
6. Impacts of Regional Water Plan and Consistency with Long-Term Protection of the Water Resources, Agricultural Resources, and Natural Resources
7. Drought Response
8. Unique Stream Segments, Unique Reservoir Sites, and Legislative Recommendations
9. Infrastructure Funding Recommendations
10. Plan Approval Process and Public Participation
11. Implementation and Comparison to Previous Regional Water Plan

Figure ES.1
Region C and Outside Water Supplies Designated as Special Water Resources for Use in Region C



This Executive Summary focuses on current water needs and supplies in Region C, the projected need for water, the identification and selection of recommended water management strategies, the costs and impacts of the selected strategies, and county summaries for each county in the region. Other elements of the plan are covered in the main text and the appendices.

ES.1 Current Water Needs and Supplies in Region C

As of the 2010 census, the population of Region C was 6,477,835, which represented 25 percent of Texas' total population. The estimated population as of July 2012 was 6,716,014, an increase of 3.7 percent in two years. The two most populous counties in Region C, Dallas and Tarrant, have 65 percent of the region's population. Region C is heavily urbanized, with 83 percent of the population located in cities with populations in excess of 20,000 people.

Physical Setting

Most of Region C is in the upper portion of the Trinity River Basin, with smaller parts in the Red, Brazos, Sulphur, and Sabine River Basins. Figure ES.1 shows the major streams in Region C. Precipitation increases from west to east in the region. The average runoff in the region also increases from the west to the east, while evaporation is higher to the west. These patterns of rainfall, runoff, and evaporation result in more abundant water supplies in the eastern part of Region C than in the west.

There are thirty-four major reservoirs in Region C with conservation storages in excess of 5,000 acre-feet. These reservoirs and others outside of Region C provide most of the region's water supply. Aquifers in the region include the Trinity, Woodbine, Carrizo-Wilcox, Nacatoch, and Queen City.

Water Use

Water use in Region C has increased significantly in recent years, primarily in response to increasing population. The regional water use in the year 2011 was 1,508,886 acre-feet. It is interesting to note that Region C, with over 25 percent of Texas' population, had only 8.3 percent of the state's water use in 2011. About 90 percent of the current water use in Region C is for municipal supply.

Current Sources of Water Supply

About 90 percent of the water use in Region C is supplied by surface water, but groundwater can be an important source of supply, especially in rural areas. Most of the surface water supply in Region C comes from major reservoirs, including reservoirs in the region and reservoirs outside of Region C that supply water for the region. The Trinity aquifer is the largest source of groundwater in Region C, with some use in the Woodbine, Carrizo-Wilcox and other minor aquifers. The current use of groundwater is close to or greater than the long-term reliable supply available in some parts of Region C.

About half of the water used for municipal supply in Region C is discharged as treated effluent from wastewater treatment plants, making wastewater reclamation and reuse a potentially significant source of water supply for the region. Reuse supplies are increasing rapidly in Region C, with several major projects recently completed or under development. It is clear that the reuse of treated wastewater will be a significant source of future water supplies for the region.

Water Providers in Region C

Water providers in Region C include 41 wholesale water providers and 360 water user groups. In 2011, the three largest wholesale water providers in Region C (Dallas Water Utilities, Tarrant Regional Water District, and North Texas Municipal Water District) provided the majority of the water used in the region. Cities and towns provide most of the retail water service in Region C.

ES.2 Projected Need for Water

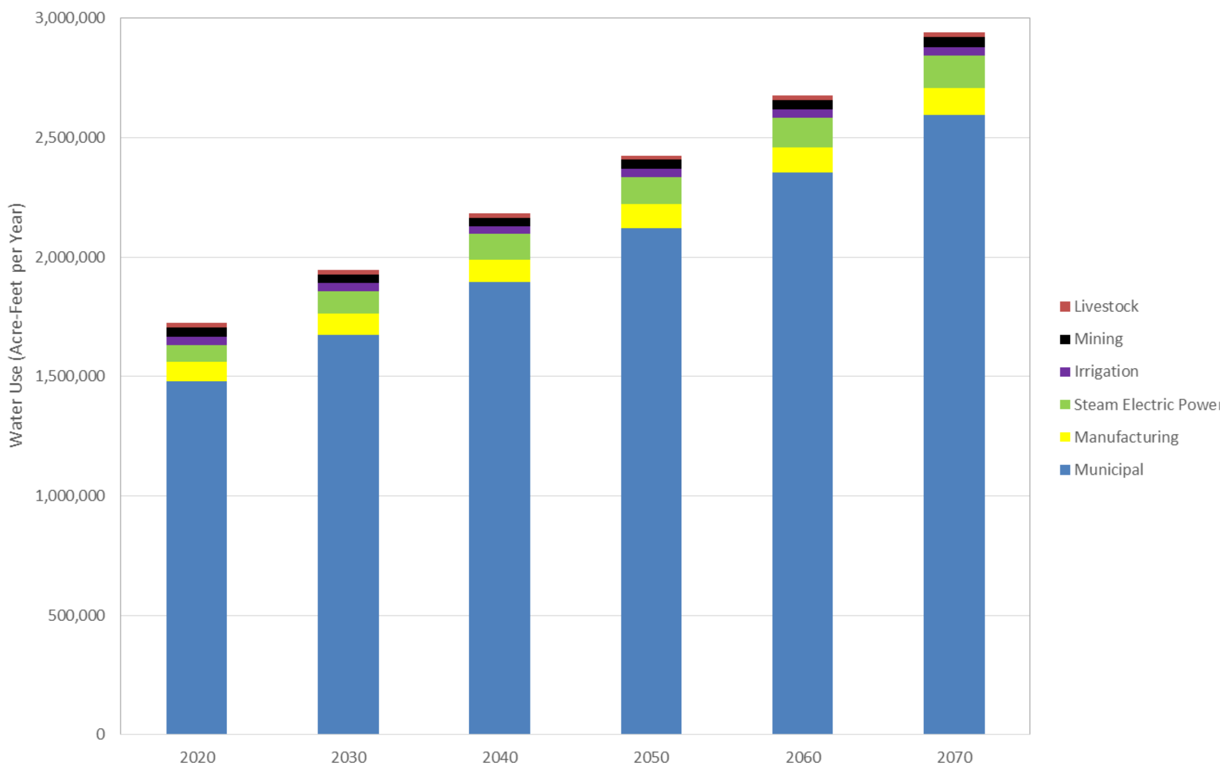
Population Projections

The population of Region C is projected to grow from 6,477,835 in the year 2010 to 9,908,572 in 2040 and 14,347,915 in 2070. These projections have been approved by the Texas Water Development Board, as required by TWDB planning guidelines. This projection reflects a substantial slowing in the rate of growth that has been experienced in Region C over the last 50 years. The distribution of the projected population by county and city is discussed in Chapter 2.

Demand Projections

Figure ES.2 shows the projected dry-year demands for water in Region C, which total 2.2 million acre-feet per year in 2040 and 2.9 million acre-feet per year in 2070. As has been the case historically, municipal demands are projected to make up the majority of the water use in Region C. The 2060 projected demand is almost 600,000 acre-feet per year lower than the projections in the *2011 Region C Water Plan*. The total municipal 2060 gallons per capita per day (gpcd) in the 2011 Plan was 200 as opposed to the total municipal gpcd of 165 in the 2016 Plan. (It should be noted that these gpcd's reflect demands before any conservation water management strategies have been applied). Dry-year demands are significantly higher than normal year demands, especially for municipal use (because of increased lawn irrigation use). Normal-year demands in Region C might be 10 to 15 percent lower than dry-year demands.

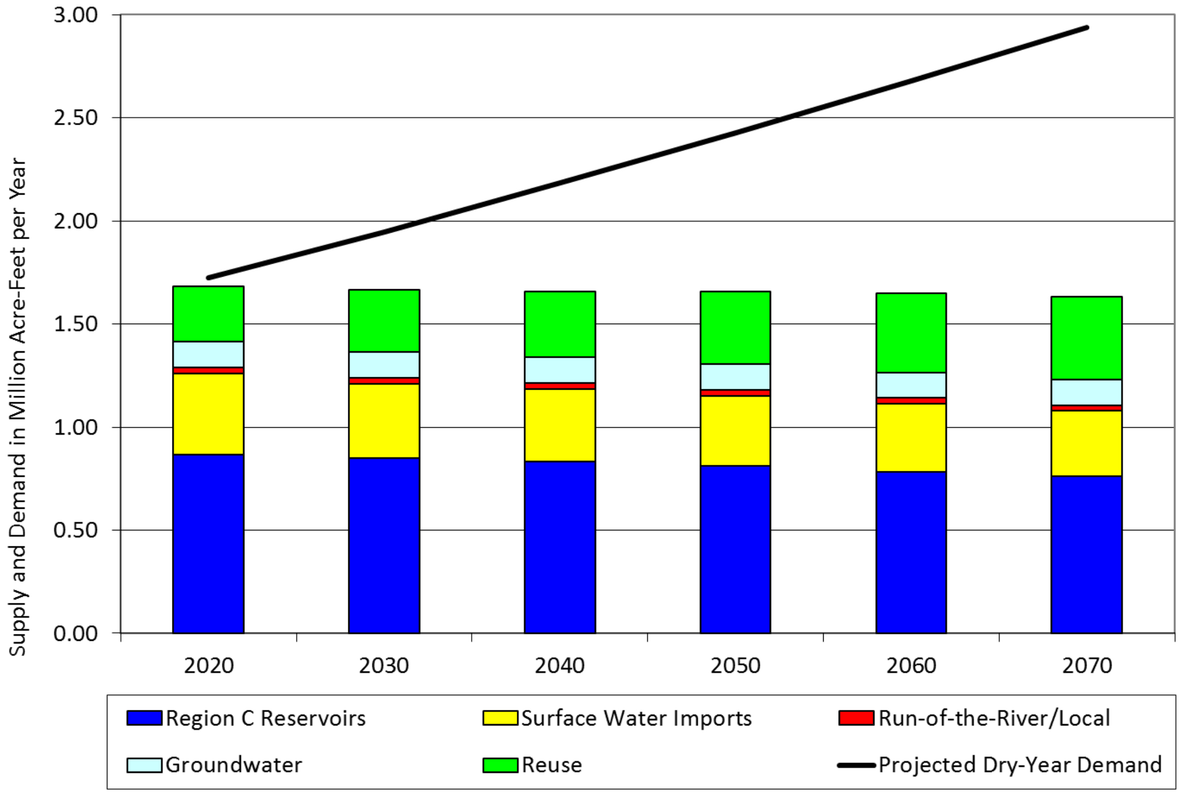
Figure ES.2
Adopted Projections for Dry-Year Water Use by Category in Region C



Comparison of Supply and Demand

Figure ES.3 shows a comparison of supplies currently available to Region C and projected demands. Currently available supplies are almost constant over time at 1.7 million acre-feet per year, as sedimentation in reservoirs is offset by increases in reuse supplies due to increased return flows. With the projected 2070 demand of 2.9 million acre-feet per year, the region has a shortage of 1.2 million acre-feet per year by 2070. Meeting the projected shortage and leaving a reasonable reserve of planned supplies beyond projected needs will require the development of significant new water supplies for Region C over the next 50 years.

Figure ES.3
Comparison of Currently Available Supplies and Projected Demands



Socio-Economic Impacts of Not Meeting Projected Water Needs

The Texas Water Development Board conducted an analysis of the socio-economic impacts of not meeting the projected water needs in Region C. By not meeting water needs in Region C, TWDB estimates the annual combined lost income in 2070 would be $34.6 billion and that 2070 employment would be reduced by over 373,000 jobs. More information on the socio-economic analysis is included in Chapter 6.

ES.3 Identification and Selection of Water Management Strategies

The Region C Water Planning Group identified and evaluated a wide variety of potentially feasible water management strategies in developing this plan. Water supply availability, costs and environmental impacts were determined for conservation and reuse efforts, the connection of existing supplies, and the development of new supplies.

As required by TWDB regulations, the evaluation of water management strategies was an equitable comparison of all feasible strategies and considered the following factors:

- Evaluation of quantity, reliability, and cost of water delivered and treated
- Environmental factors
- Impacts on other water resources and on threats to agricultural and natural resources
- Other factors deemed relevant by the planning group (including consistency with the plans of water providers in the region)
- Consideration of interbasin transfer requirements and third party impacts of voluntary redistributions of water.

Water Conservation and Reuse

The Region C Water Planning Group considered the municipal water conservation strategies suggested as best management practices by the Conservation Implementation Task Force and recommended a water conservation program and reuse projects for Region C that accomplish the following:

- Including the 246,869 acre-feet per year of conservation built into the demand projections (for low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards), a total conservation and reuse supply of over 1.16 million acre-feet per year by 2070, 41 percent of the region's demand without conservation.
- A dry-year per capita municipal use for the region (after crediting for conservation and reuse) ranging from 119 gpcd in 2020 to 105 gpcd by 2070.

Chapter 5E includes a more detailed discussion of conservation and reuse for the region.

Recommended Water Management Strategies

Table ES.1 lists the major recommended water management strategies for Region C. (Major water management strategies are those supplying over 60,000 acre-feet per year or involving the construction of a reservoir.) Table ES.3 at the end of this chapter lists all the recommended water management strategies. Figure ES.4 shows the location of the recommended major water management strategies. In total, the Region C plan includes water management strategies to develop 1.79 million acre-feet per year of new supplies, for a total available supply of 3.43 million acre-feet per year in 2070. The supply is about 16 percent greater than the projected demand, leaving a reasonable reserve to provide for difficulties in developing strategies in a timely manner, droughts worse than the drought of record, greater than expected growth, and supply for needs beyond this planning horizon.

Figure ES.5 shows the makeup of the 3.43 million acre-feet per year of supplies proposed to be available to the region by 2070. About 37 percent of the supply is already available to the region from surface water and groundwater; a little over a quarter (27 percent) is developed from conservation and reuse efforts, 16 percent is from the connection of existing supplies, and 20 percent is from the development of new supply including reservoirs and run-of-river projects.

The plan includes only five major new reservoirs (compared to more than 25 developed to supply water for Region C over the last 60 years.)

Cost of the Proposed Plan

Most of the new supplies for Region C will be developed by the major wholesale water providers in the region. Table ES.2 shows the amount of new supply proposed for the five largest wholesale water providers in Region C and the cost to develop that supply. The total cost of implementing all of the water management strategies in the plan is $23.6 billion. The specific recommended water management strategies recommended for wholesale water providers and water user groups are discussed in sections 5C and 5D of the report.

Table ES.1
Recommended Major Water Management Strategies for Region C

Strategy	Supplier	Supply in 2070 (Ac-Ft/Yr)	Supplier Capital Cost
Conservation	Multiple	135,991	$420,878,859
Reuse Implementation (Main Stem Trinity River)	Dallas	149,093	$718,944,000
Connect Lake Palestine	Dallas	110,670	$900,817,000
Sulphur Basin Supplies	TRWD	280,000	$3,004,413,000
	NTWMD	174,800	$1,206,634,000
	UTRWD	35,000	$305,499,000
Lower Bois d'Arc Creek Reservoir	NTWMD	120,200	$625,610,000
Toledo Bend	NTWMD	100,000	$1,248,461,000
Cedar Creek Wetlands (Reuse)	TRWD	88,059	$139,078,000
Lake Texoma blending	NTWMD	97,838	$521,775,000
Lake Columbia	Dallas	56,050	$327,187,000
Lake Ralph Hall and Associated Reuse	UTRWD	50,121	$316,160,000
Oklahoma	NTWMD	50,000	$167,541,000
Neches Run-of-River	Dallas	47,250	$226,790,000
Lake Tehuacana	TRWD	41,600	$742,730,000
Lake Texoma Desalination	GTUA	41,076	$142,222,000

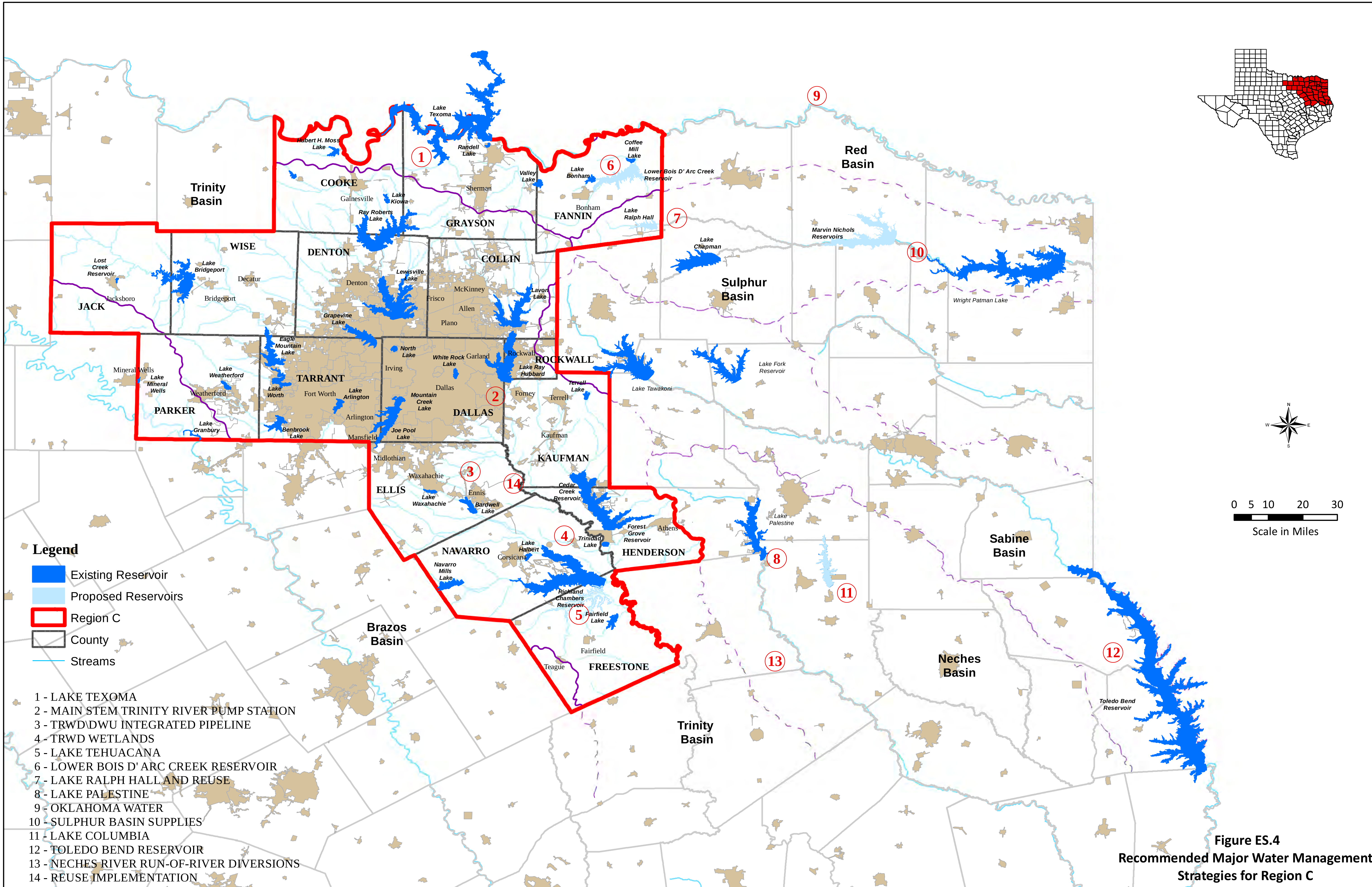


Figure ES.4
Recommended Major Water Management Strategies for Region C

Figure ES.5
Sources of Water Available to Region C as of 2070

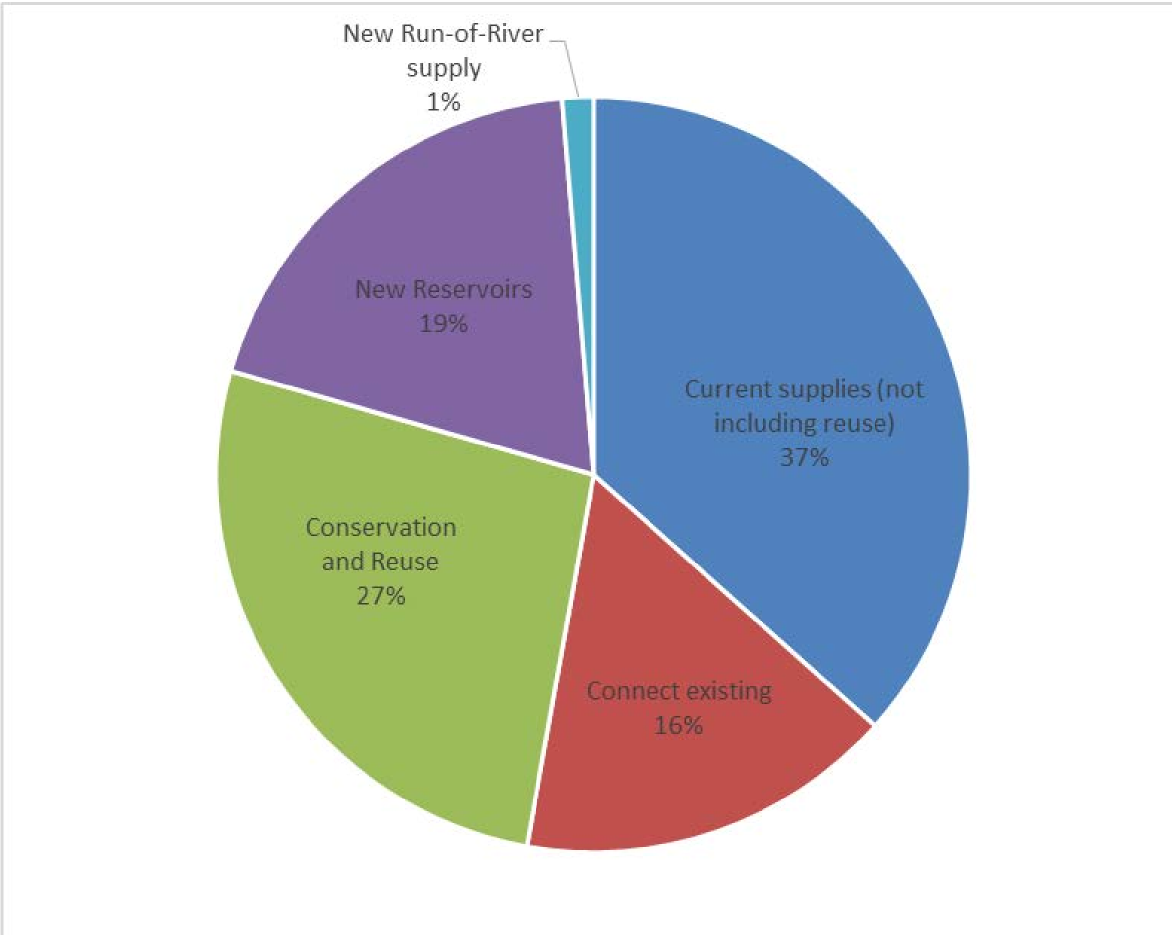


Table ES.2
2070 Supplies for the Largest Wholesale Providers and for Region C

Wholesale Water Provider	Supplies Available in 2070 from Current Sources[(a)]	Supplies Available in 2070 from New Strategies[(a)]	Total Supplies Available in 2070[(a)]	% of Total Supply from Conservation and Reuse	Cost of Strategies (Millions)
Dallas Water Utilities	506,363	414,323	920,686	31.9%	$4,265
Tarrant Regional Water District	489,024	483,702	972,726	23.4%	$5,620
North Texas Municipal Water District	383,146	580,122	963,268	20.6%	$8,209
City of Fort Worth	282,992	257,766	540,757	26.1%	$1,198
Trinity River Authority	114,996	142,426	257,422	42.8%	$81
Upper Trinity Regional Water District	41,002	130,566	171,568	26.9%	$1,325
Greater Texoma Utility Authority	23,333	69,837	93,170	10.0%	$240
Total for Region C[(b)]	**1,631,508**	**1,795,148**	**3,426,565**		**$23,640**

2070 Demand in Region C	**2,939,880**
Management Supply Factor for Region C	**1.166**

Notes:
(a) Current sources include only those that are connected. Some supplies are used by more than one supplier. For example, TRWD supplies water to TRA and Fort Worth, DWU supplies water to UTRWD, etc.
(b) Total for Region C is not a sum of the numbers above. It includes other providers as well. Some supplies serve multiple suppliers.

Table ES.3
Summary of Recommended Strategies - Region C WWPs and WUGs*

**volumes shown in gray italics are infrastructure projects to utilize the supply volumes from other strategies*

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (acre-feet/year)	First Decade Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2070 Water Supply Volume (acre-feet/year)	Year 2070 Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2020 Water Supply Volume (acre-feet/year)	Year 2030 Water Supply Volume (acre-feet/year)	Year 2040 Water Supply Volume (acre-feet/year)	Year 2050 Water Supply Volume (acre-feet/year)	Year 2060 Water Supply Volume (acre-feet/year)	Year 2070 Water Supply Volume (acre-feet/year)
Multiple	Conservation - Municipal	$420,878,859	Q-10	2020	55,532	$853	131,108	$153	55,532	88,085	96,213	108,956	120,028	131,108
Multiple	Conservation - Non-Municipal	$0	Q-11	2020	34	$310	4,883	$310	34	731	2,936	4,053	4,488	4,883
Dallas	Main Stem Pump Station	$44,481,000	Q-34	2020	34,751	$153	34,751	$46	34,751	34,751	34,751	34,751	34,751	34,751
Dallas	Main Stem Balancing Reservoir (Reuse)	$674,463,000	Q-35	2050	84,075	$607	114,342	$175	0	0	0	84,075	102,011	114,342
Dallas	Connect Lake Palestine (Palestine to IPL, Dallas Portion of IPL, IPL to Bachman)	$900,817,000	Q-36, Q-37, Q-48	2030	110,670	$1,524	106,239	$834	0	110,670	109,563	108,455	107,347	106,239
Dallas	Neches Run-of-River	$226,790,000	Q-38	2060	47,250	$697	47,250	$697	0	0	0	0	47,250	47,250
Dallas	Lake Columbia	$327,187,000	Q-39	2070	56,050	$914	56,050	$914	0	0	0	0	0	56,050
Dallas	Infrastructure to Treat & Deliver to Customers	$2,087,784,000	Q-40	2020	*34,751*	$569	*358,632*	$82	34,751	145,421	144,314	227,281	291,359	358,632
Tarrant Regional WD	Integrated Pipeline (IPL)	$1,733,914,000	Q-48	2020	*71,270*	$1,084	*123,091*	$239	71,270	102,480	122,353	135,403	132,461	123,091
Tarrant Regional WD	Additional Cedar Creek Lake	$0		2020	32,636	$0	15,898	$0	32,636	30,583	28,315	25,609	21,368	15,898
Tarrant Regional WD	Add'l Richland-Chambers Reuse	$0		2020	38,634	$0	19,134	$0	38,634	34,734	30,834	26,934	23,034	19,134
Tarrant Regional WD	Cedar Creek Reuse	$139,078,000	Q-49	2030	37,163	$182	88,059	$50	0	37,163	63,204	82,860	88,059	88,059
Tarrant Regional WD	Tehuacana	$742,730,000	Q-50	2040	41,600	$1,382	41,600	$150	0	0	41,600	41,600	41,600	41,600
Tarrant Regional WD	Sulphur Basin Supply	$3,004,413,000	Q-18	2050	72,670	$1,131	280,000	$267	0	0	0	72,670	72,670	280,000
North Texas MWD	Removal of Chapman Silt Barrier	$1,793,000	Q-19	2020	3,620	$20	3,135	N/A	3,620	3,523	3,426	3,329	3,232	3,135
North Texas MWD	Dredge Lake Lavon	$1,967,000	Q-20	2020	7,959	$20	6,390	N/A	7,959	7,735	7,399	7,062	6,726	6,390
North Texas MWD	Add'l measure to access full Lavon yield	$20,823,000	Q-21	2020	14,461	$205	10,130	$84	14,461	13,505	12,661	11,818	10,974	10,130
North Texas MWD	Main Stem PS (additional East Fork wetlands - TRA)	$71,743,000	Q-22	2020	53,088	$153	0	$46	53,088	37,913	25,366	13,599	3,235	0
North Texas MWD	Lower Bois d'Arc Creek Res.	$625,610,000	Q-23	2020	16,815	$506	113,600	$71	16,815	120,200	120,200	118,000	115,800	113,600
North Texas MWD	Lake Chapman Pump Station Expansion	$25,638,000	Q-24	2020										
North Texas MWD	Additional Lake Texoma - Blend with Lower Bois d'Arc water	$174,179,000	Q-25	2040	39,571	$518	37,867	$150	0	0	39,571	39,333	38,600	37,867
North Texas MWD	Sulphur Basin Supplies	$1,206,634,000	Q-18	2060	45,367	$710	174,800	$710	0	0	0	0	45,367	174,800
North Texas MWD	Additional Lake Texoma - Blend with Sulphur Basin water	$347,596,000	Q-26	2060	15,122	$642	58,267	$642	0	0	0	0	15,122	58,267
North Texas MWD	Toledo Bend Phase 1	$1,248,461,000	Q-57	2060	100,000	$1,325	100,000	$1,325	0	0	0	0	100,000	100,000
North Texas MWD	Oklahoma	$167,541,000	Q-27	2070	50,000	$508	50,000	$508	0	0	0	0	0	50,000
North Texas MWD	Infrastructure to Treat & Deliver to Customers								0	0	0	0	0	0
North Texas MWD	Fannin County Water Supply System	$45,753,900	Q-150	2020	*56*	$914	*12,760*	$614	56	912	2,436	4,666	8,466	12,760
North Texas MWD	Treatment and Distribution (CIP)	$4,270,998,000	Q-28	2020	*95,943*	$837	*554,189*	$194	95,943	182,876	208,623	193,141	339,056	554,189
Fort Worth	Alliance Direct Reuse	$16,083,000	Q-68	2020	2,800	$161	7,841	$20	2,800	2,800	7,841	7,841	7,841	7,841
Fort Worth	Future Direct Reuse	$129,976,000	Q-67	2020	2,688	$1,363	8,166	$268	2,688	6,934	8,166	8,166	8,166	8,166
Fort Worth	Eagle Mountain 35 mgd expansion	$68,472,000	Q-13	2030	*19,618*	$417	*19,618*	$124	0	19,618	19,618	19,618	19,618	19,618
Fort Worth	West Plant 23 mgd expansion	$48,082,000	Q-13	2030	*12,892*	$446	*12,892*	$134	0	12,892	12,892	12,892	12,892	12,892
Fort Worth	Rolling Hills 50 mgd expansion	$93,960,000	Q-13	2030	*414*	$401	*28,025*	$121	0	414	28,025	28,025	28,025	28,025
Fort Worth	West Plant 35 mgd expansion	$68,472,000	Q-13	2040	*19,618*	$417	*19,618*	$124	0	0	19,618	19,618	19,618	19,618
Fort Worth	Eagle Mountain 30 mgd expansion	$59,977,000	Q-13	2040	*15,710*	$427	*16,815*	$127	0	0	15,710	16,815	16,815	16,815
Fort Worth	50 mgd expansion-1	$93,960,000	Q-13	2050	*28,025*	$401	*28,025*	$121	0	0	0	28,025	28,025	28,025
Fort Worth	50 mgd expansion-2	$93,960,000	Q-13	2050	*13,099*	$401	*28,025*	$121	0	0	0	13,099	28,025	28,025
Fort Worth	50 mgd expansion-3	$93,960,000	Q-13	2060	*23,923*	$401	*28,025*	$401	0	0	0	0	23,923	28,025
Fort Worth	50 mgd expansion-4	$93,960,000	Q-13	2070	*28,025*	$401	*28,025*	$401	0	0	0	0	0	28,025

Table ES.3

Summary of Recommended Strategies - Region C WWPs and WUGs*

***volumes shown in gray italics are infrastructure projects to utilize the supply volumes from other strategies**

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (acre-feet/year)	First Decade Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2070 Water Supply Volume (acre-feet/year)	Year 2070 Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2020 Water Supply Volume (acre-feet/year)	Year 2030 Water Supply Volume (acre-feet/year)	Year 2040 Water Supply Volume (acre-feet/year)	Year 2050 Water Supply Volume (acre-feet/year)	Year 2060 Water Supply Volume (acre-feet/year)	Year 2070 Water Supply Volume (acre-feet/year)
Fort Worth	50 mgd expansion-5	$93,960,000	Q-13	2070	*7,913*	$401	*7,913*	$401	0	0	0	0	0	7,913
Fort Worth	Cost Participation in Water delivery line to Customers (Trophy Club and Westlake)	$5,233,000	Q-197	2020	*0*	N/A	*0*	N/A	0	0	0	0	0	0
Trinity River Authority	TRWD Water:													
Trinity River Authority	Tarrant Co. WSP	$0		2030	*1,629*	$316	*17,205*	$316	0	1,629	6,922	11,204	14,388	17,205
Trinity River Authority	Ellis Co. WSP	$0		2020	*3,726*	$316	*49,386*	$316	3,726	6,698	10,932	16,783	26,616	49,386
Trinity River Authority	Freestone County SEP	$0		2030	*604*	$0	*2,920*	$0	0	604	1,315	1,945	2,462	2,920
Trinity River Authority	Ennis Indirect Reuse	Included in Ennis costs in Table 5C.41		2040	*518*	$0	*3,696*	$0	0	0	518	1,392	3,696	3,696
Trinity River Authority	Joe Pool Lake Reuse**	N/A	None	2020	1,914	N/A	4,368	N/A	1,914	2,835	4,041	4,368	4,368	4,368
Trinity River Authority	Additional Los Colinas Reuse	$15,017,000	Q-58	2020	7,000	$392	7,000	$212	7,000	7,000	7,000	7,000	7,000	7,000
Trinity River Authority	Dallas County Reuse (SEP)	$8,661,000	Q-59	2030	2,000	$590	2,000	$228	0	2,000	2,000	2,000	2,000	2,000
Trinity River Authority	Ellis County Reuse (SEP)	$17,958,000	Q-60	2060	2,200	$557	4,700	$557	0	0	0	0	2,200	4,700
Trinity River Authority	Freestone Co. Reuse (SEP)	$30,593,000	Q-61	2050	6,760	$613	6,760	$235	0	0	0	6,760	6,760	6,760
Trinity River Authority	Kaufman Co. Reuse (SEP)	$8,763,000	Q-62	2020	1,000	$935	1,000	$283	1,000	1,000	1,000	1,000	1,000	1,000
Trinity River Authority	Tarrant and Denton Co. Reuse	Included in Fort Worth costs in Table 5C.10		2020	*3,921*	$0	*11,537*	$0	3,921	3,921	11,537	11,537	11,537	11,537
Trinity River Authority	Central Reuse to Irving	Included in Irving costs in Section 5D.		2020	*28,025*	$0	*28,025*	$0	28,025	28,025	28,025	28,025	28,025	28,025
Trinity River Authority	Central Reuse to NTMWD (via Main Stem Pump Station)	Included in NTMWD costs in Table 5C.8		2020	*53,088*	$0	*0*	$0	53,088	37,913	25,366	13,599	3,235	0
Upper Trinity RWD	Chapman Silt Barrier	Included under NTMWD in Table 5C.8		2020	998	$0	864	$0	998	972	945	918	891	864
Upper Trinity RWD	Additional Supplies from DWU (Up to Current Contracts)*	$0		2020	*1,819*	$482	*18,017*	$482	1,819	6,205	11,048	14,115	16,458	18,017
Upper Trinity RWD	Lake Ralph Hall	$316,160,000	Q-52	2030	34,050	$584	34,050	$80	0	34,050	34,050	34,050	34,050	34,050
Upper Trinity RWD	Lake Ralph Hall Indirect Reuse	$0	None	2030	9,733	$0	16,071	$0	0	9,733	14,967	15,335	15,703	16,071
Upper Trinity RWD	Additional Direct Reuse	$13,213,000	Q-53	2030	560	$590	2,240	$94	0	560	1,121	2,240	2,240	2,240
Upper Trinity RWD	Contract Renewal with Commerce for Lake Chapman supply	$0	None	2040	2,813	$3	5,547	$3	0	0	2,813	2,799	2,786	5,547
Upper Trinity RWD	Contract Renewal with Commerce for Lake Chapman - Reuse	$0	None	2040	1,428	$0	3,069	$0	0	0	1,428	1,464	1,500	3,069
Upper Trinity RWD	Additional DWU (Contract Increase)	$0	None	2050	*5,605*	$482	*11,210*	$482	0	0	0	5,605	11,210	11,210
Upper Trinity RWD	Sulphur Basin Supplies	$305,499,000	Q-18	2060	9,083	$906	35,000	$906	0	0	0	0	9,083	35,000
Upper Trinity RWD	Treatment and Distribution System Improvements	$690,554,000	Q-54	2020	*2,817*		*126,068*		2,817	51,520	66,372	76,526	93,921	126,068
Greater Texoma UA	Texoma Raw water to Grayson Co SEP	$24,356,000	Q-63	2030	6,548	$388	6,548	$78	0	6,548	6,548	6,548	6,548	6,548
Greater Texoma UA	Texoma Raw water to Fannin Co SEP	$25,026,000	Q-128	2030	9,000	$287	9,000	$52	0	9,000	9,000	9,000	9,000	9,000
Greater Texoma UA	Grayson County Water Supply Project (Treatment of Lake Texoma)	$92,840,000	Q-64	2020	187	$841	25,528	$534	187	1,990	4,333	7,214	13,903	25,528
Greater Texoma UA	Add'l NTMWD (Current CGMA Facilities)	$0	None	2020	*142*	$570	*0*	$570	142	659	1,708	0	0	0

Table ES.3

Summary of Recommended Strategies - Region C WWPs and WUGs*

**volumes shown in gray italics are infrastructure projects to utilize the supply volumes from other strategies*

Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (acre-feet/year)	First Decade Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2070 Water Supply Volume (acre-feet/year)	Year 2070 Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2020 Water Supply Volume (acre-feet/year)	Year 2030 Water Supply Volume (acre-feet/year)	Year 2040 Water Supply Volume (acre-feet/year)	Year 2050 Water Supply Volume (acre-feet/year)	Year 2060 Water Supply Volume (acre-feet/year)	Year 2070 Water Supply Volume (acre-feet/year)
Greater Texoma UA	CGMA-East West Pipeline (NTMWD)	$3,672,000	Q-65	2050	*4,698*	$877	*11,400*	$847	0	0	0	4,698	11,400	11,400
Greater Texoma UA	Parallel CGMA Pipeline (NTMWD)	$59,492,000	Q-66	2060	*3,533*	$1,232	*14,541*	$1,232	0	0	0	0	3,533	14,541
Dallas County PCMUD	None													
Corsicana	New 8 MGD Halbert/Richland Chambers WTP (4 mgd increase from current plant)	$37,370,000	Q-12	2020	2,242	$1,991	2,242	$596	2,242	2,242	2,242	2,242	2,242	2,242
Corsicana	Raw Water for Power Plant (Pipeline and PS)	$16,331,000	Q-167	2030	5,440	$323	5,440	$72	0	5,440	5,440	5,440	5,440	5,440
Corsicana	8 MGD Expansion of Halbert/Richland Chambers WTP and expansion of pump station	$21,689,000	Q-13	2050	4,484	$577	4,484	$173	0	0	0	4,484	4,484	4,484
Argyle WSC	Additional UTRWD	$0		2020	*0*	$976	*1,857*	$976	0	375	1,033	1,473	1,690	1,857
Arlington	Additional Water from TRWD	$0		2030	*4,780*	$316	*31,464*	$316	0	4,780	12,711	19,936	26,082	31,464
Athens MWA	Fish Hatchery Reuse	$0	None	2020	2,872	$33	2,872	$33	2,872	2,872	2,872	2,872	2,872	2,872
Athens MWA	Infrastructure Improvements at WTP	$2,900,000	Q-145	2020	*1,682*	$59	*1,682*	$37	1,682	1,682	1,682	1,682	1,682	1,682
Cross Timbers WSC	Additional UTRWD	$0		2030	*208*	$976	*923*	$976	0	208	452	673	814	923
Cross Timbers WSC	Infrastructure to take delivery from UTRWD and to deliver water to customers	$5,858,000	Q-99	2020	*208*	$639	*923*	$111	0	208	452	673	814	923
Denison	4 MGD WTP Expansion	$13,168,000	Q-13	2030	2,242	$701	2,242	$209	0	2,242	2,242	2,242	2,242	2,242
Denison	4 MGD New WTP	$19,888,000	Q-12	2060	2,242	$1,059	2,242	$1,059	0	0	0	0	2,242	2,242
Denison	4 MGD WTP Expansion	$13,168,000	Q-13	2070	2,242	$701	2,242	$701	0	0	0	0	0	2,242
Denison	Expand Raw Water delivery from Lake Texoma	$21,629,700	Q-137	2030	*2,242*	$785	*6,726*	$94	0	2,242	2,242	2,242	4,484	6,726
Denton	Existing supplies made available by treatment below:			2020	6,590		11,144		6,590	8,273	10,195	11,956	11,550	11,144
Denton	30 mgd Ray Roberts Plant Expansion	$59,881,000	Q-13	2020	*2,674*	$424	*16,815*	$127	2,674	10,926	16,815	16,815	16,815	16,815
Denton	20 mgd Ray Roberts Plant Expansion	$42,922,000	Q-13	2040	*3,368*	$456	*11,210*	$137	0	0	3,368	11,210	11,210	11,210
Denton	30 mgd Ray Roberts Plant Expansion	$59,881,000	Q-13	2050	*16,815*	$424	*16,815*	$127	0	0	0	4,147	16,815	16,815
Denton	25 mgd Treatment Plant Expansion-1	$51,402,000	Q-13	2060	*8,396*	$437	*14,013*	$437	0	0	0	0	8,396	14,013
Denton	25 mgd Treatment Plant Expansion-2	$51,402,000	Q-13	2070	*11,318*	$541	*11,318*	$541	0	0	0	0	0	11,318
East Cedar Creek FWSD	Additional TRWD	$0		2030	*147*	$316	*1,779*	$316	0	147	391	655	1,079	1,779
East Cedar Creek FWSD	2 mgd Treatment Plant Expansion	$8,904,000	Q-13	2070	*962*	$948	*962*	$948	0	0	0	0	0	962
Ennis	Indirect Reuse	$39,456,900	Q-108	2040	*518*	$1,374	*3,696*	$481	0	0	518	1,392	3,696	3,696
Ennis	Additional TRWD	$0	None	2030	*93*	$316	*13,143*	$316	0	93	285	1,084	3,807	13,143
Ennis	6 MGD WTP expansion	$17,433,000	Q-13	2040	*56*	$619	*3,363*	$186	0	0	56	2,479	3,363	3,363
Ennis	8 MGD WTP expansion	$21,697,000	Q-13	2060	*4,142*	$577	*4,484*	$577	0	0	0	0	4,142	4,484
Ennis	16 MGD WTP expansion	$36,138,000	Q-13	2070	*8,992*	$479	*8,992*	$479	0	0	0	0	0	8,992
Forney	Additional NTMWD	$0		2020	*504*	$554	*9,339*	$554	504	1,789	2,712	3,760	5,695	9,339
Forney	Increase delivery infrastructure from NTWMD (pump station)	$11,162,800	Q-154	2050	*0*	$94	*9,339*	$39	504	1,789	2,712	3,760	5,695	9,339
Gainesville	2.5 MGD WTP Expansion	$9,970,000	Q-13	2060	560	$850	1,401	$850	0	0	0	0	560	1,401
Gainesville	6 MGD WTP Expansion	$17,431,000	Q-13	2070	3,298	$632	3,298	$632	0	0	0	0	0	3,298
Gainesville	Infrastructure to deliver to customers	$26,296,000	Q-82	2030	*204*	$2,243	*1,825*	$1,037	0	204	293	393	937	1,825
Gainesville	Expand Direct Reuse	$1,669,000	Q-81	2020	70	$2,330	70	$342	70	70	70	70	70	70
Garland	Additional NTMWD	$0		2020	*2,610*	$554	*16,896*	$554	2,610	8,870	11,946	13,393	15,074	16,896
Grand Prairie	DWU Pipeline and Additional DWU	$34,306,000	Q-88	2020	*719*	$313	*11,282*	$59	719	3,274	7,252	9,105	10,344	11,282
Grand Prairie	Additional Fort Worth (TRWD)	$0		2020	*0*	$639	*1,286*	$639	0	495	831	1,016	1,159	1,286
Grand Prairie	Mansfield (TRWD)	$0		2020	*3,240*	$815	*4,018*	$815	3,240	3,188	3,296	3,490	3,773	4,018

Table ES.3
Summary of Recommended Strategies - Region C WWPs and WUGs*

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Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (acre-feet/year)	First Decade Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2070 Water Supply Volume (acre-feet/year)	Year 2070 Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2020 Water Supply Volume (acre-feet/year)	Year 2030 Water Supply Volume (acre-feet/year)	Year 2040 Water Supply Volume (acre-feet/year)	Year 2050 Water Supply Volume (acre-feet/year)	Year 2060 Water Supply Volume (acre-feet/year)	Year 2070 Water Supply Volume (acre-feet/year)
Grand Prairie	Arlington (TRWD)	$4,950,500	Q-87	2020	1,100	$1,039	2,197	$850	1,100	1,092	1,665	1,660	2,205	2,197
Lake Cities MUA	Additional UTRWD	$0		2030	417	$976	1,612	$976	0	417	912	1,330	1,479	1,612
Mansfield	Add'l TRWD Supply	$0		2020	11,730	$316	38,705	$316	11,730	14,385	19,068	27,424	32,870	38,705
Mansfield	15 MGD WTP Expansion	$34,489,000	Q-13	2021	8,408	$489	8,408	$147	8,408	8,408	8,408	8,408	8,408	8,408
Mansfield	20 MGD WTP Expansion-1	$42,984,000	Q-13	2025	3,322	$456	11,210	$137	3,322	5,977	10,660	11,210	11,210	11,210
Mansfield	20 MGD WTP Expansion-2	$42,984,000	Q-13	2050	7,806	$456	11,210	$137	0	0	0	7,806	11,210	11,210
Mansfield	16 MGD WTP Expansion	$36,188,000	Q-13	2060	2,042	$482	7,877	$482	0	0	0	0	2,042	7,877
Midlothian	Add'l TRWD	$0		2020	1,421	$316	11,178	$316	1,421	3,031	5,297	7,402	9,286	11,178
Midlothian	6 MGD WTP Expansion-1	$17,433,000	Q-13	2020	1,246	$619	3,363	$186	1,246	3,031	3,363	3,363	3,363	3,363
Midlothian	6 MGD WTP Expansion-2	$17,433,000	Q-13	2040	1,934	$619	3,363	$186	0	0	1,934	3,363	3,363	3,363
Midlothian	6 MGD WTP Expansion-3	$17,433,000	Q-13	2060	2,560	$619	3,363	$619	0	0	0	0	2,560	3,363
Mustang SUD	Additional UTRWD Supplies	$0		2030	2,243	$976	12,022	$976	0	2,243	5,092	7,991	10,088	12,022
Mustang SUD	Infrastructure to deliver to customers	$0		2030	2,243	$0	12,022	$0	0	2,243	5,092	7,991	10,088	12,022
North Richland Hills	Additional TRA (from TRWD)	$0		2030	283	$945	1,712	$945	0	283	727	1,114	1,431	1,712
North Richland Hills	Additional Fort Worth (from TRWD)	$0		2020	5,078	$639	5,067	$639	5,078	5,390	5,145	4,987	4,925	5,067
North Richland Hills	New Pipeline from Fort Worth (Cost share with Watagua)	$8,091,833	Q-199	2020	5,078	$297	5,067	$40	5,078	5,390	5,145	4,987	4,925	5,067
Princeton	Additional NTMWD	$0		2020	91	$554	3,594	$554	91	358	616	1,418	2,374	3,594
Rockett SUD	Additional Midlothian with Increase in Infrastructure (20" line)	$11,874,000	Q-115	2020	124	$854	1,394	$140	124	504	860	1,101	1,273	1,394
Rockett SUD	Additional TRWD/TRA	$0	None	2020	4,934	$316	24,899	$316	4,934	7,303	10,124	12,610	16,996	24,899
Rockett SUD	Sokoll 10 MGD Expansion-1	$25,961,000	Q-13	2020	4,934	$554	5,605	$166	4,934	5,605	5,605	5,605	5,605	5,605
Rockett SUD	Sokoll 10 MGD Expansion-2	$25,961,000	Q-13	2030	1,698	$554	5,605	$166	0	1,698	4,519	5,605	5,605	5,605
Rockett SUD	Sokoll 10 MGD Expansion-3	$25,961,000	Q-13	2050	1,400	$554	5,605	$166	0	0	0	1,400	5,605	5,605
Rockett SUD	Sokoll 10 MGD Expansion-4	$25,961,000	Q-13	2070	5,605	$554	5,605	$554	0	0	0	0	0	5,605
Rockwall	Additional NTMWD	$0		2020	749	$554	12,990	$554	749	4,175	5,995	7,659	10,080	12,990
Rockwall	Increase delivery infrastructure from NTWMD	$22,551,000	Q-183	2020	0	$182	12,990	$39	0	1,457	3,901	6,426	10,080	12,990
Seagoville	Additional DWU beyond Current Contract	$0		2020	1,107	$482	5,756	$482	1,107	1,511	2,047	2,688	4,094	5,756
Seagoville	Infrastructure to take delivery from Dallas	$0		2020	0	$0	0	$0	0	0	0	0	0	0
Seagoville	Infrastructure to deliver to customers	$0		2020	0	$0	0	$0	0	0	0	0	0	0
Sherman	Grayson County Water Supply Project:													
Sherman	*10 MGD WTP Expansion (desal)*	$17,328,500	Q-13	2020	5,605	$919	5,605	$401	5,605	5,605	5,605	5,605	5,605	5,605
Sherman	*10 MGD New WTP (desal)*	$34,657,000	Q-12	2050	5,605	$919	5,605	$401	0	0	0	5,605	5,605	5,605
Sherman	*20 MGD WTP Expansion (desal)*	$29,478,000	Q-13	2070	11,210	$782	11,210	$782	0	0	0	0	0	11,210
Terrell	Additional NTMWD	$0		2020	340	$570	13,616	$570	340	1,854	3,776	6,587	9,936	13,616
Terrell	Infrastructure Upgrades to Deliver water to Wholesale Customers	$3,714,000	Q-157	2020	340	$616	11,210	$587	340	1,854	3,776	6,587	9,936	13,616
Terrell		$1,569,100	Q-158	2030	2,803	$632	2,803	$587						
Terrell		$1,514,500	Q-159	2040	4,484	$613	4,484	$583						
Terrell		$4,418,700	Q-160	2040	4,484	$671	4,484	$590						
Terrell		$1,395,100	Q-161	2020	6,726	$600	6,726	$583						
Terrell		$5,688,500	Q-162	2030	4,484	$704	4,484	$600						
Terrell	Additional Connection to NTMWD	$25,559,100	Q-163	2040	340	$776	13,452	$616	340	1,854	3,776	6,587	9,936	13,616

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Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (acre-feet/year)	First Decade Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2070 Water Supply Volume (acre-feet/year)	Year 2070 Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2020 Water Supply Volume (acre-feet/year)	Year 2030 Water Supply Volume (acre-feet/year)	Year 2040 Water Supply Volume (acre-feet/year)	Year 2050 Water Supply Volume (acre-feet/year)	Year 2060 Water Supply Volume (acre-feet/year)	Year 2070 Water Supply Volume (acre-feet/year)
Walnut Creek SUD	Additional TRWD	$0	None	2030	*218*	$316	*5,662*	$316	0	218	686	1,476	3,291	5,662
Walnut Creek SUD	6 MGD WTP New	$9,245,000	Q-12	2030	*218*	$534	*3,363*	$303	0	218	686	1,476	3,291	3,363
Walnut Creek SUD	0 MGD WTP Expansion-2	$0	$0	2050	*0*	$0	*0*	$0	0	0	0	0	0	0
Walnut Creek SUD	0 MGD WTP Expansion-3	$0	$0	2060	*0*	$0	*0*	$0	0	0	0	0	0	0
Walnut Creek SUD	New 12 MGD Eagle Mountain WTP	$53,337,000	Q-12	2070	*2,299*	$948	*2,299*	$948	0	0	0	0	0	2,299
Waxahachie	Dredge Lake Waxahachie	$31,973,500	Q-123	2030	705	$3,796	705	NA	0	705	705	705	705	705
Waxahachie	Add'l TRA/TRWD	$0	None	2040	*2,659*	$355	*12,389*	$355	0	0	2,659	4,809	7,900	12,389
Waxahachie	Ellis County Steam Electric Supply Project	$15,009,000	Q-107	2040	*2,116*	$342	*4,484*	$62	0	0	2,116	4,129	4,484	4,484
Waxahachie	Existing Reuse made usable through additional treatment below:				510		884		510	671	1,104	1,319	1,020	884
Waxahachie	8 MGD Expansion of Howard Rd WTP	$21,697,000	Q-13	2030	*4,484*	$577	*4,484*	$173	0	4,484	4,484	4,484	4,484	4,484
Waxahachie	10 MGD Expansion of Howard Rd WTP	$25,961,000	Q-13	2050	*5,605*	$554	*5,605*	$166	0	0	0	5,605	5,605	5,605
Waxahachie	12 MGD Expansion of Howard Rd WTP	$29,353,000	Q-13	2070	*6,726*	$521	*6,726*	$521	0	0	0	0	0	6,726
Waxahachie	36" Raw water line from IPL to Lake Waxahachie	$1,073,400	Q-120	2030	*16,815*	$325	*16,815*	$317	0	4,484	4,484	10,089	10,089	16,815
Waxahachie	27" Raw water line from IPL to Howard Road Water Treatment Plant	$3,176,400	Q-119	2030	*16,815*	$372	*16,815*	$321	0	4,484	4,484	10,089	10,089	16,815
Waxahachie	36" Raw water line from Lake Waxahachie to Howard Rd WTP	$5,465,000	Q-121	2030	*16,815*	$48	*16,815*	$6	0	4,484	4,484	10,089	10,089	16,815
Waxahachie	Phase I Delivery Infrastructure to Customers in South Ellis County	$15,220,700	Q-125	2030	*1,121*	$558	*1,121*	$78	0	281	1,121	1,121	1,121	1,121
Waxahachie	Phase II Delivery Infrastructure to Customers in South Ellis County	$23,452,433	Q-126	2050	*5,875*	$572	*5,875*	$64	0	0	1,638	4,105	5,165	5,875
Waxahachie	48" TRWD Parallel Supply Line to Sokoll WTP	$3,510,500	Q-122	2030	*16,815*	$330	*16,815*	$317	0	4,484	4,484	10,089	10,089	16,815
Waxahachie	Increase delivery infrastructure to Rockett SUD (30" Raw water Line)	$11,894,900	Q-124	2030	*16,815*	$163	*16,815*	$15	0	4,484	4,484	10,089	10,089	16,815
Waxahachie	Raw Water Intake Improvements at Lake Bardwell	$5,168,200	Q-127	2030	*16,815*	$53	*16,815*	$27	0	4,484	4,484	10,089	10,089	16,815
Weatherford	Indirect Reuse - Lake Weatherford/Sunshine	$13,089,000	Q-177	2020	2,240	$580	2,240	$91	2,240	2,240	2,240	2,240	2,240	2,240
Weatherford	Add'l Water from TRWD	$0	None	2030	*55*	$316	*22,486*	$316	0	55	628	4,589	12,490	22,486
Weatherford	8 MGD WTP Expansion*	$36,408,000	Q-13	2020	*1,000*	$1,026	*4,484*	$345	1,000	1,000	1,000	4,484	4,484	4,484
Weatherford	14 MGD New WTP	$60,521,000	Q-12	2050	*2,345*	$922	*7,847*	$277	0	0	0	2,345	7,847	7,847
Weatherford	24 MGD WTP Expansion	$49,781,000	Q-13	2070	*12,395*	$479	*12,395*	$479	0	0	0	0	0	12,395
Weatherford	Expand Lake Benbrook PS	$2,301,800	Q-178	2030	*0*	$756	*0*	$326	0	0	0	0	0	0
West Cedar Creek MUD	Additional TRWD	$0	None	2020	*283*	$316	*4,170*	$316	283	566	902	1,346	2,537	4,170
West Cedar Creek MUD	6 MGD WTP Expansion	$17,429,000	Q-13	2050	*427*	$639	*3,251*	$192	0	0	0	427	1,618	3,251
Wise County WSD	Additional TRWD	$0	None	2020	*1,657*	$316	*10,397*	$316	1,657	2,383	3,205	5,859	8,136	10,397
Wise County WSD	10 MGD WTP Expansion-1	$25,992,000	Q-13	2020	*1,657*	$554	*5,605*	$166	1,657	2,383	3,205	5,605	5,605	5,605
Wise County WSD	10 MGD WTP Expansion-2	$25,992,000	Q-13	2050	*254*	$648	*4,792*	$192	0	0	0	254	2,531	4,792
WUGs by County														
Collin County														
Blue Ridge	Connection to NTMWD	$2,403,656	Q-69	2020	*109*	$678	*2,242*	$590	0	109	308	1,363	2,242	2,242
Blue Ridge	Upsize connection to NTMWD	$1,036,000	Q-70	2060	*895*	$603	*3,080*	$603	0	0	0	0	895	3,080

Table ES.3

Summary of Recommended Strategies - Region C WWPs and WUGs*

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Entity	Recommended Strategy	Capital Cost	Cost Table	First Decade of Water Strategy	First Decade Water Supply Volume (acre-feet/year)	First Decade Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2070 Water Supply Volume (acre-feet/year)	Year 2070 Estimated Annual Average Unit Cost ($/acre-foot/year)	Year 2020 Water Supply Volume (acre-feet/year)	Year 2030 Water Supply Volume (acre-feet/year)	Year 2040 Water Supply Volume (acre-feet/year)	Year 2050 Water Supply Volume (acre-feet/year)	Year 2060 Water Supply Volume (acre-feet/year)	Year 2070 Water Supply Volume (acre-feet/year)
Celina*	Connect to NTWMD	$16,314,000	Q-71	2020	*1,500*	$345	*5,000*	$72	0	1,500	3,000	5,000	5,000	5,000
East Fork SUD*	Increase delivery infrastructure from NTWMD	$3,500,000	Q-181	2020	*74*	$795	*1,624*	$616	74	308	483	758	1,108	1,624
Frisco*	Direct reuse	$34,882,048	Q-74	2020	2,240	$740	5,650	$222	2,240	3,360	5,650	5,650	5,650	5,650
Melissa	Treated water supply line from NTMWD	$2,124,324	Q-75	2020	*44*	$877	*237*	$127	44	131	165	188	211	237
Parker	Increase delivery infrastructure from NTMWD	$1,651,000	Q-76	2030	*3,810*	$44	*5,309*	$18	0	3,810	5,398	5,366	5,337	5,309
Prosper*	Increase delivery infrastructure from NTWMD	$3,786,000	Q-77 & Q-78	2020	*2,385*	$72	*10,874*	$13	0	2,385	5,243	8,098	10,934	10,874
Weston	Additional Groundwater (new wells)	$824,000	Q-215	2020	71	$1,348	71	$376	71	71	71	71	71	71
Weston	Connect to NTMWD and supplies	$27,130,000	Q-79	2020	*829*	$173	*18,237*	$49	0	829	4,600	11,501	18,301	18,237
Wylie Northeast SUD	Increase delivery infrastructure from NTWMD	$4,250,000	Q-80	2020	*37*	$437	*979*	$75	37	163	243	360	594	979
Collin County Manufacturing	Additional Groundwater (new wells)	$402,800	Q-72	2030	78	$635	78	$199	0	78	78	78	78	78
Cooke County														
Muenster	Develop Muenster Lake supply	$8,504,000	Q-85	2020	280	$4,392	280	$1,851	280	280	280	280	280	280
Cooke County Mining	Direct Reuse (On-Site recycling)	$0	None	2020	99	$163	80	$163	99	67	71	74	77	80
Dallas County														
Glenn Heights*	Increase delivery infrastructure from DWU	$2,374,000	Q-86	2060	*289*	$137	*1,925*	$137	0	0	0	0	289	1,925
Irving	Lake Chapman Silt Barrier Removal	Included under NTMWD in Table 5C.8	$0	2020	3,418	$0	2,960	NA	3,418	3,326	3,235	3,143	3,052	2,960
Irving	TRA Central Reuse Project	$39,960,000	Q-90	2020	28,025	$497	28,025	$377	28,025	28,025	28,025	28,025	28,025	28,025
Irving	Lake Chapman Booster Pump Station	$8,546,000	Q-24	2020	0	NA	0	NA						
Dallas County Irrigation	Los Colinas Expansion	See TRA in Section 5C.	$0	2030	*7,000*	See TRA	*7,000*	See TRA	0	7,000	7,000	7,000	7,000	7,000
Dallas County Steam Electric	Reuse (TRA)	See TRA in Section 5C.	$0	2030	*2,000*	See TRA	*2,000*	See TRA	0	2,000	2,000	2,000	2,000	2,000
Rowlett	Increase delivery infrastructure from NTMWD	$3,519,000	Q-214	2020	*695*	$678	*4,125*	$609	695	2,332	2,937	3,296	3,683	4,125
Sunnyvale	Additional pipeline from DWU	$22,408,000	Q-93	2020	*142*	$1,414	*2,279*	$593	142	695	1,138	1,495	2,023	2,279
Wilmer	New Connection to Dallas (via Lancaster)	$4,504,300	Q-95	2020	*207*	$564	*800*	$91	207	242	300	400	600	800
Wilmer	Direct Connection to Dallas 36" Transmission Line	$15,999,500	Q-94	2040	*382*	$528	*2,859*	$59	0	0	382	876	1,409	2,859
Denton County														
Corinth	Upsize existing well	$2,372,900	Q-98	2020	286	$1,029	286	$333	286	286	286	286	286	286
Corinth	New wells in Trinity Aquifer-2020	$1,634,600	Q-96	2020	847	$457	847	$212	847	847	847	847	847	847
Corinth	New wells in Trinity Aquifer-2030	$1,634,600	Q-97	2030	561	$457	561	$212	0	561	561	561	561	561
Denton County Other	New wells in Trinity Aquifer	$2,772,023	Q-102	2020	504	$1,005	504	$310	504	504	504	504	504	504
Denton County Other	New wells in Woodbine Aquifer	$11,691,860	Q-101	2020	817	$1,361	817	$383	817	817	817	817	817	817
Hackberry	Increase delivery infrastructure from NTWMD	$1,731,000	Q-103	2050	*70*	$502	*348*	$85	0	0	0	70	200	348
Justin	New wells in Trinity Aquifer	$2,115,500	Q-104	2020	244	$0	244	$302	244	244	244	244	244	244
Krum	New wells in Trinity Aquifer	$1,533,200	Q-105	2020	577	$299	1,025	$175	577	707	866	1,025	1,025	1,025
Lewisville*	6 MGD WTP Expansion-2030	$17,433,000	Q-13	2030	*1,386*	$619	*3,363*	$186	0	1,386	3,363	3,363	3,363	3,363

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Lewisville*	6 MGD WTP Expansion-2040	$17,433,000	Q-13	2040	*1,081*	$0	*3,363*	$0	0	0	1,081	3,363	3,363	3,363
Lewisville*	7 MGD WTP Expansion-2050	$19,565,000	Q-13	2050	*845*	$0	*3,743*	$0	0	0	0	845	3,879	3,743
Pilot Point	Additional groundwater	$865,605	Q-106	2020	269	$497	269	$229	269	269	269	269	269	269
Trophy Club	Phase I-Increase delivery infrastructure from Ft Worth; joint project with Ft Worth, Westlake, Trophy Club	$2,273,000	Q-197	2020	*896*	$162	*2,560*	$13	0	896	1,621	2,009	2,305	2,560
Trophy Club	Phase II-Increase delivery infrastructure from Ft Worth; 24" line	$7,292,600	Q-198	2020	*896*	$260	*2,560*	$22	0	896	1,621	2,009	2,305	2,560
Denton County Manufacturing	Additional groundwater	$777,700	Q-100	2020	184	$604	184	$251	184	184	184	184	184	184
Ellis County														
Ferris	Increase delivery infrastructure from Rockett SUD in future	$2,578,000	Q-109	2060	*394*	$202	*1,395*	$202	0	0	0	0	394	1,395
Files Valley WSC	Connect to Waxahachie (TRWD through TRA)	See Waxahachie in Section 5C.2	$0	2030	*55*	$0	*72*	$0	0	55	59	63	68	72
Mountain Peak SUD*	Additional wells (Woodbine)	$1,812,605	Q-112	2020	7	$727	7	$145	7	7	7	7	7	7
Ovilla*	Increase delivery infrastructure from DWU	$8,136,000	Q-92	2070	*1,494*	$573	*1,494*	$573	0	0	0	0	0	1,494
Palmer	Increase delivery infrastructure from Rockett SUD	$6,628,000	Q-113	2020	*10*	$694	*940*	$104	10	72	151	245	387	940
Rice WSC*	Increase delivery infrastructure from Corsicana	$6,983,000	Q-114	2040	*156*	$675	*1,038*	$114	0	0	156	402	698	1,038
Sardis-Lone Elm WSC	Increase delivery Infrastructure from Rockett SUD	$1,992,000	Q-118	2020	*548*	$138	*1,318*	$13	0	0	548	1,026	1,342	1,318
Sardis-Lone Elm WSC	Connect to Midlothian	$255,200	Q-117	2020	*1,121*	$21	*1,121*	$2	1,121	1,121	1,121	1,121	1,121	1,121
Ellis County Steam Electric	Waxahachie	See Waxahachie in Section 5C.2	$0	2040	*2,116*	$0	*4,484*	$0	0	0	2,116	4,129	4,484	4,484
Ellis County Steam Electric	TRA direct reuse	See TRA in Section 5C.1	0	2060	*2,200*	See TRA	*4,700*	See TRA	0	0	0	0	2,200	4,700
Fannin County														
Ladonia	Lake Ralph Hall supply	$12,134,600	Q-129	2030	*34*	$14,204	*133*	$6,629	0	34	57	89	134	133
Leonard	Water System Improvements	$2,567,600	Q-207	2020	*148*	$1,153	*273*	$366	0	148	194	211	240	273
Southwest Fannin Co SUD*	Additional Groundwater (with transmission facilities)	$2,348,823	Q-130	2030	100	$2,559	100	$589	0	100	100	100	100	100
Trenton	New Wells in Woodbine Aquifer	$971,785	Q-131	2030	25	$4,148	25	$908	0	25	25	25	25	25
Fannin County Steam Electric	Lake Texoma (GTUA)	See GTUA in Section 5C.1.	$0	2030	*9,000*	$0	*9,000*	$0	0	9,000	9,000	9,000	9,000	9,000
Freestone County														
Fairfield	New Water Treatment Plant and transmission	$7,283,000	Q-132	2050	*191*	$880	*897*	$202	0	0	0	191	426	897
Freestone County Other	Increase delivery infrastructure from Corsicana	$5,550,000	Q-133	2020	*40*	$2,053	*266*	$306	0	40	44	64	119	266
Freestone County Other	New delivery and treatment facilities from TRWD	$39,845,900	Q-134	2030	*189*	$1,388	*3,207*	$349	189	145	115	368	1,175	3,207
Teague	New Wells in Carrizo-Wilcox Aquifer	$1,145,600	Q-135	2050	200	$765	200	$285	0	0	0	200	200	200

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Freestone County Steam Electric	Additional TRWD supplies through TRA	$0	None	2030	*604*	$0	*8,587*	$0	0	604	1,315	1,945	2,462	8,587
Freestone County Steam Electric	TRA direct reuse	See TRA in Section 5C	$0	2050	*6,760*	See TRA	*6,760*	See TRA	0	0	0	6,760	6,760	6,760
Grayson County														
Bells	New well in Woodbine Aquifer	$1,200,000	Q-136	2030	145	$1,102	145	$412	0	145	145	145	145	145
Gunter	New wells	$2,080,600	$0	2020	100	$4,660	100	$1,180	50	100	100	100	100	100
Southmayd	New Well in Woodbine	$1,068,000	Q-141	2070	77	$1,530	77	$1,530	0	0	0	0	0	77
Van Alstyne	Water System Improvements	$2,180,800	Q-142	2030	*14*	$766	*1,370*	$632	0	14	47	87	646	1,370
Grayson County Mining	New well in Trinity Aquifer	$164,000	Q-138	2050	41	$463	41	$122	0	0	0	41	41	41
Grayson County Steam Electric	Additional Lake Texoma (GTUA)	See GTUA in Section 5C.1.	$0	2030	*6,548*	$0	*6,548*	$0	0	6,548	6,548	6,548	6,548	6,548
Henderson County														
Eustace	New well in Carrizo-Wilcox	$912,400	Q-146	2020	103	$992	103	$254	103	103	103	103	103	103
Payne Springs	Additional Wells (Carrizo-Wilcox)	$892,000	Q-148	2020	145	$749	145	$232	145	145	145	145	145	145
Henderson County Steam Electric (Region C only)	TRWD (Cedar Creek Lake)	$19,951,000	Q-147	2030	*4,500*	$274	*7,950*	$65	4,500	4,500	4,950	5,950	6,950	7,950
Jack County														
Jack County Other	Jacksboro (Lost Creek/Lake Jacksboro)	$1,893,000	Q-151	2020	*7*	$24,432	*7*	$1,812	7	7	7	7	7	7
Jack County Other	Walnut Creek SUD	$2,713,000	Q-152	2020	*48*	$5,018	*51*	$570	48	49	49	50	50	51
Jack County Mining	Indirect reuse (Jacksboro)	$0	None	2020	330	$815	359	$815	330	342	348	351	356	359
Kaufman County														
College Mound WSC	Increase delivery from Terrell	$5,348,000	Q-153	2020	*55*	$525	*1,028*	$88	55	220	346	475	725	1,028
Gastonia-Scurry SUD	Connect to Seagoville (DWU)	$4,577,500	Q-155	2020	*39*	$238	*1,799*	$26	39	39	39	39	569	1,799
Kaufman County Other	0.8 MGD Water Treatment Plant for TRWD water	$11,922,000	Q-149	2020	*86*	$3,418	*457*	$1,235	86	91	127	194	331	457
Mabank*	2 MGD WTP Expansion	$8,905,000	Q-13	2030	*67*	$948	*1,121*	$283		67	249	717	1,121	1,121
Mabank*	3 MGD WTP Expansion	$11,037,000	Q-13	2060	*326*	$1,004	*1,313*	$1,004					326	1,313
Mabank*	Increase delivery infrastructure from Cedar Creek Lake	$262,000	Q-143	2060	*1,447*	$11	*2,434*	$11	0	67	249	717	1,447	2,434
Kaufman County Mining	Trinity Aquifer New well	$484,000	Q-216	2040	344	$154	344	$35	0	0	344	344	344	344
Kaufman County Mining	Connect to NTWMD	$4,098,000	Q-156	2060	*3*	$2,317	*171*	$2,317	0	0	0	0	3	171
Kaufman County Steam Electric	TRA direct reuse	See TRA in Section 5C	$0	2020	*1,000*	See TRA	*1,000*	See TRA	1,000	1,000	1,000	1,000	1,000	1,000
Navarro County														
Blooming Grove	Groundwater	$1,669,300	Q-164	2020	160	$1,350	160	$475	160	160	160	160	160	160
Chatfield WSC	New Well	$1,000,000	Q-165	2020	150	$936	150	$376	150	150	150	150	150	150
MEN WSC	Increase delivery infrastructure from Corsicana (Upsize Lake Halbert Connection)	$2,521,800	Q-166	2030	*173*	$632	*408*	$114	0	173	214	268	334	408

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Navarro Mills WSC	New wells (Woodbine)	$1,339,500	Q-168	2050	79	$993	79	$370	0	0	0	79	79	79
Parker County														
Aledo	Parallel pipeline and pump station from Fort Worth	$7,710,500	Q-169	2040	*67*	$2,665	*269*	$336	0	0	67	164	277	269
Annetta	Connect to Weatherford (TRWD)	$2,077,600	Q-171	2030	*25*	$2,216	*196*	$1,326	0	25	28	35	90	196
Annetta North	Connect to Weatherford (TRWD)	$59,400	Q-171	2040	*7*	$1,395	*38*	$1,264	0	0	7	16	25	38
Annetta South	Connect to Weatherford (TRWD)	$1,183,300	Q-171	2040	*5*	$6,136	*22*	$1,636	0	0	5	10	16	22
Cresson*	New wells in Trinity Aquifer	$917,300	Q-170	2020	113	$941	113	$259	113	113	113	113	113	113
Parker County Other	Water Treatment Plant and Transmission Facilities	$116,775,000	Q-174	2060	*3,635*	$1,668	*9,618*	$1,668	0	0	0	0	3,635	9,618
Parker County Other	New wells in Trinity Aquifer	$1,448,000	Q-173	2020	200	$849	200	$244	200	200	200	200	200	200
Parker County SUD*	Additional BRA with 1 MGD Treatment Plant Expansion	$6,776,000	Q-13	2020	540	$1,499	540	$450	540	540	540	540	540	540
Parker County SUD*	Additional Groundwater (new wells in Trinity aquifer)	$3,860,000	Q-172	2060	513	$881	513	$881	0	0	0	0	513	513
Springtown	Infrastructure improvements at Lake intake	$280,200	Q-175	2020	*67*	$119	*236*	$25	67	244	237	230	227	236
Springtown	New wells in Trinity Aquifer	$998,400	Q-176	2020	70	$1,566	70	$366	70	70	70	70	70	70
Willow Park	Connect to Weatherford (TRWD) Phase I	$588,100	Q-171	2030	*137*	$1,444	*1,562*	$1,284	0	137	306	706	1,135	1,562
Rockwall County														
Blackland WSC*	Direct Connection to NTMWD	$3,295,550	Q-179	2020	*48*	$407	*356*	$65	48	153	204	246	296	356
Cash SUD	Increase delivery infrastructure from NTWMD	$6,654,700	Q-180	2020	*1,165*	$531	*1,042*	$53	1,165	1,075	782	824	927	1,042
Fate	Increase delivery infrastructure from NTMWD	$15,075,000	Q-182	2060	*390*	$528	*2,982*	$528	0	0	0	0	390	2,982
Tarrant County														
Azle*	Water treatment plant expansion	$11,046,000	Q-13	2020	*162*	$805	*1,641*	$241	162	255	383	607	925	1,641
Benbrook	Water treatment plant expansions	$13,715,000	Q-13	2060	*2,342*	$701	*2,307*	$701	0	0	0	0	2,342	2,307
Bethesda WSC*	Connection to Arlington	$18,698,000	Q-184	2020	*1,416*	$704	*2,614*	$104	1,416	1,619	1,833	2,072	2,336	2,614
Blue Mound	Purchase Existing Water System from Monarch Utilities	$5,000,000	Q-185	2020	*0*	NA	*0*	NA	0	0	0	0	0	0
Burleson*	Increase delivery infrastructure from Fort Worth	$21,780,000	Q-186	2040	*967*	$401	*5,541*	$72	0	0	967	2,386	3,922	5,541
Crowley	Increase delivery infrastructure from Fort Worth	$11,558,000	Q-187	2030	*184*	$394	*3,028*	$75	0	184	678	1,297	2,347	3,028
Johnson County SUD*	Connect to Grand Prairie	$86,140,000	Q-188	2020	*6,726*	$1,248	*6,726*	$176	6,726	6,726	6,726	6,726	6,726	6,726
Keller	Increase delivery infrastructure from Fort Worth	$17,535,000	Q-189	2030	*2,170*	$196	*5,679*	$49	0	2,170	3,697	4,516	5,139	5,679
Kennedale	Increase delivery infrastructure from Ft Worth	$3,685,000	Q-191	2040	*188*	$1,284	*277*	$192	0	0	188	239	283	277
Kennedale	Connect to Arlington	$1,720,000	Q-190	2020	*280*	$619	*280*	$104	280	280	280	280	280	280
Pantego	Connect to Arlington	$778,000	Q-192	2030	*27*	$2,776	*24*	$345	0	27	27	26	25	24
Pantego	Connect to Fort Worth	$831,000	Q-193	2030	*27*	$3,001	*24*	$385	0	27	27	26	25	24
Pelican Bay	Azle (TRWD)	$956,000	Q-194	2030	*11*	$7,332	*12*	$714	0	11	11	11	11	12
Southlake*	Increase delivery infrastructure from Ft Worth	$43,035,000	Q-195	2020	*141*	$479	*8,349*	$46	0	141	2,157	4,198	6,264	8,349

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Watauga	Increase delivery infrastructure North Richland Hills/Fort Worth	$1,874,676	Q-199	2020	*980*	$69	*1,225*	$9	980	1,119	1,254	1,208	1,192	1,225
Westlake*	Increase delivery infrastructure from Ft Worth; joint project with Ft Worth, Westlake, Trophy Club	$2,961,000	Q-197	2020	*42*	$162	*3,335*	$13	42	705	1,596	2,181	2,765	3,335
Tarrant County Steam Electric	Direct reuse	$13,080,000	Q-196	2030	1,528	$560	2,360	$94	0	1,528	2,360	2,360	2,360	2,360
Wise County														
Bridgeport	2 MGD WTP Expansion	$8,911,000	Q-13	2050	*40*	$948	*1,121*	$283				40	827	1,121
Bridgeport	1.5 MGD WTP Expansion	$7,844,000	Q-13	2070	*489*	$1,916	*489*	$1,916						489
Bridgeport	Expand Capacity of Lake intake and Pump Station	$766,100	Q-200	2050	*40*	$50	*1,610*	$11	0	0	0	40	827	1,610
Chico	Increase delivery capacity from West Wise SUD	$3,610,000	Q-201	2050	*140*	$942	*369*	$124	0	0	0	140	246	369
New Fairview	Connect to Rhome (TRWD through Walnut Creek SUD)	$3,662,000	Q-202	2030	*34*	$1,619	*221*	$238	0	34	71	119	165	221
Newark	Connect to Rhome (TRWD through Walnut Creek SUD)	$2,548,000	Q-203	2030	*51*	$371	*646*	$42	0	51	147	261	437	646
Runaway Bay	0.5 MGD Water Treatment Plant Expansion	$4,078,000	Q-13	2070	*100*	$4,855	*100*	$4,855	0	0	0	0	0	100
Runaway Bay	Increase capacity of lake intake	$52,500	Q-204	2070	*100*	$51	*100*	$51	0	0	0	0	0	100
West Wise SUD	0.8 MGD Water Treatment Plant Expansion	$5,697,000	Q-13	2050	*54*	$2,209	*308*	$661	0	0	0	54	172	308
Wise County Manufacturing	New wells	$1,636,600	Q-205	2020	250	$757	250	$209	250	250	250	250	250	250

Introduction

In 1997, the 75th Texas Legislature passed Senate Bill One, legislation designed to address Texas water issues. Senate Bill One put in place a grass-roots regional process to plan for the future water needs of all Texans. To implement this process, the Texas Water Development Board created 16 regional water planning groups across the state and established regulations governing regional planning efforts. The results of the first round of the Senate Bill One planning effort for Region C can be found in the *2001 Region C Water Plan* [(1)]. The regional plans from each of the 16 regions were compiled by the Texas Water Development Board into the State Water Plan, *Water for Texas – 2002*.

In 2001 and 2007, the Texas Legislature passed Senate Bill Two and Senate Bill Three, respectively. These bills included the funding mechanisms to continue the regional water planning effort, which is to be updated every five years. Senate Bill Two provided the funding for the first update to the regional water plans which produced the *2006 Region C Water Plan* [(2)]. Senate Bill Three provided the funding for the 2011 update to the regional water plans, including the *2011 Region C Water Plan* [(3)].

This report gives the results of the latest (4th) round of planning for Region C. Figure I.1 is a map of Region C, which covers all or part of 16 counties in North Central Texas. As Figure I.1 shows, Region C includes all of Collin, Cooke, Dallas, Denton, Ellis, Fannin, Freestone, Grayson, Jack, Kaufman, Navarro, Parker, Rockwall, Tarrant, and Wise Counties and the part of Henderson County that is in the Trinity Basin. The area covered by Region C is the same as in the first three rounds of Senate Bill One planning.

The regional water planning groups created pursuant to Senate Bill One are in charge of the regional planning process. Each regional planning group includes representatives of 12 designated interest groups. Table I.1 shows the members of the Region C water planning group and the interests they represent. The Region C Water Planning Group hired a team of consultants to conduct technical analyses and prepare the regional water plan under the supervision of the planning group. The consulting team for Region C included Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.

[(1)] Numbers in parentheses match references listed at the end of each chapter.

Texas Water Development Board planning guidelines require the regional water plan to include the following eleven chapters:

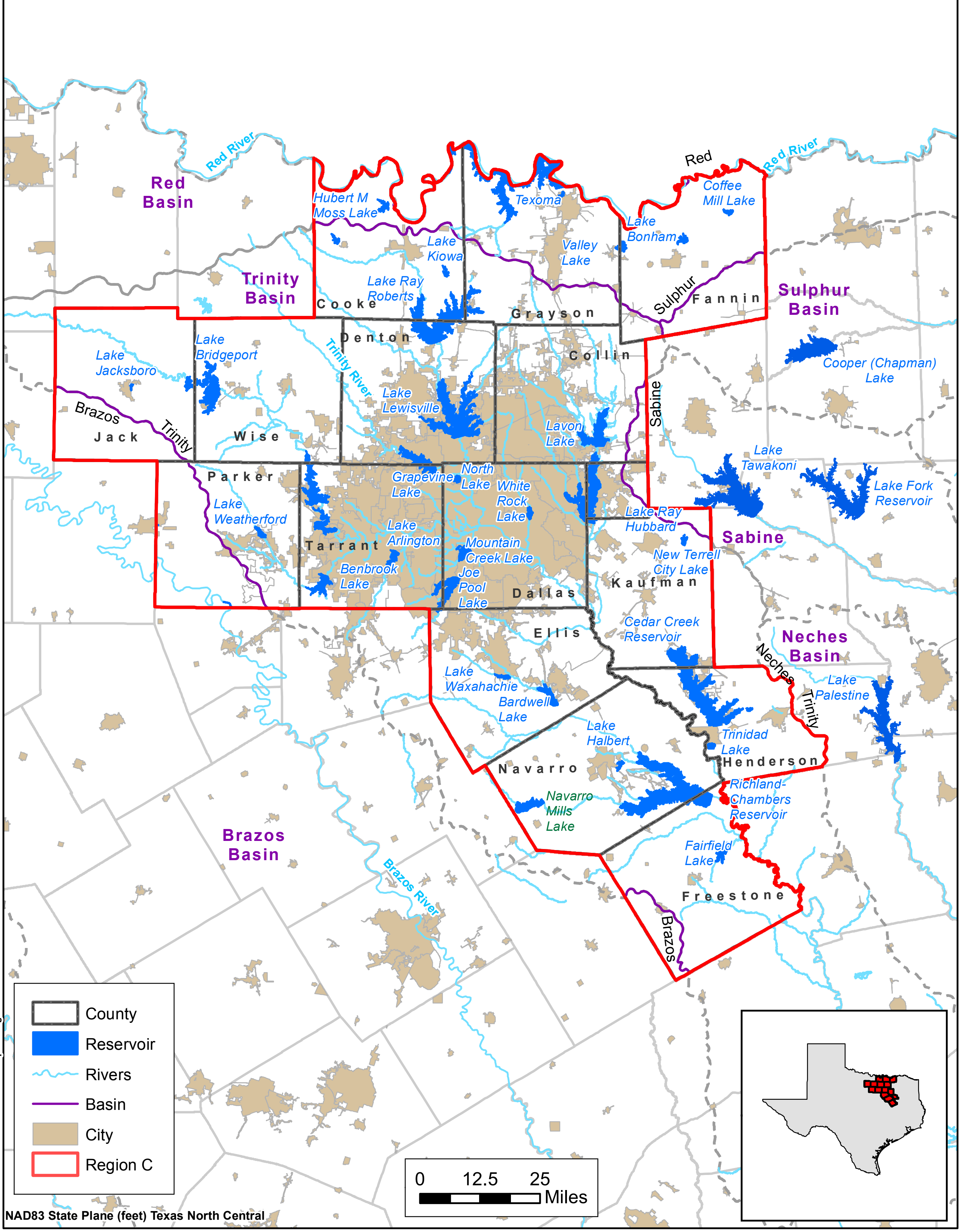
1. Description of Region C
2. Population and Water Demand Projections
3. Water Availability and Existing Water Supplies in Region C
4. Identification of Water Needs
5. Water Management Strategies
6. Impacts of the Region C Water Plan
7. Drought Response Information, Activities, and Recommendations
8. Unique Stream Segments and Reservoir Sites, and Policy Recommendations
9. Reporting of Financing for Water Management Strategies
10. Adoption of Plan and Public Participation
11. Implementation and Comparison to the Previous Region C Water Plan

In addition to the eleven required sections, this report also includes appendices providing more detailed information on the planning efforts. The elements contained in this plan meet Texas Water Development Board regional planning requirements and guidelines. Appendix X contains a summary of the requirements of all regional plans and a checklist demonstrating what sections of this report meet those guidelines.

Table I.1
Members of the Region C Water Planning Group

Member	Interest
Jody Puckett, Chairman	Municipalities
Russell Laughlin, Vice Chair	Industry
Kevin Ward, Secretary	River Authorities
David Bailey	Groundwater Management Areas (GMA12)
John Carman	Municipalities
Bill Ceverha	Public
Gary Douglas	Groundwater Management Areas (GMA11)
James Hotopp	Municipalities
Tom Kula	Water Districts
Harold Latham	Groundwater Management Areas (GMA8)
John Lingenfelder	Public
G.K. Maenius	Counties
Howard Martin	Municipalities
Jim McCarter	Water Utilities
Steve Mundt	Small Business
Bob Riley	Environment
Drew Satterwhite	Water Districts
Bob Scott	Environmental Interests
Gary Spicer	Electric Generating Utilities
Connie Standridge	Water Utilities
Jack Stevens	Water Districts
Tom Woodward	Agricultural Interests

Figure I.1
Region C and Outside Water Supplies Designated as Special Water Resources for Use in Region C



INTRODUCTION
LIST OF REFERENCES

(1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2001.

(2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2006.

(3) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

1 Description of Region C

Region C includes all or part of 16 counties in North Texas. The population of the region has grown from 987,925 in 1930 to 6,716,014 as of July 2012. As of 2011, Region C included 26 percent of Texas' total population. The two most populous counties in Region C, Dallas and Tarrant, have 65 percent of the region's population [(1)]. Table 1.1 shows the cities in Region C with a population of 20,000 or more in 2011. These cities include 83 percent of the year 2011 population of the region.

1.1 Economic Activity in Region C

Region C includes most of the Dallas and Fort Worth-Arlington metropolitan statistical areas (MSAs). The largest employment sector in the Dallas and Fort Worth-Arlington MSA is trade, followed by the service industry and government [(2)], all of which are heavily dependent on water resources.

Payroll and employment in Region C are concentrated in the central urban counties of Dallas and Tarrant, which have 76 percent of the region's total payroll and 74 percent of the employment. (Economic activity is more concentrated than population because many workers commute from outlying counties to work in Dallas and Tarrant Counties.)

1.2 Water-Related Physical Features in Region C

Most of Region C is located in the upper portion of the Trinity River Basin, with smaller parts in the Red, Brazos, Sulphur, and Sabine Basins. With the exception of the Red River Basin, the predominant flow of the streams is from northwest to southeast, as is true for most of Texas. The Red River flows west to east, forming the north border of Region C, and its major tributaries in Region C flow southwest to northeast. Major streams in Region C include the Brazos River, Red River, Trinity River, Clear Fork Trinity River, West Fork Trinity River, Elm Fork Trinity River, East Fork Trinity River, and numerous other tributaries of the Trinity River.

Table 1.1
Cities in Region C with Year 2011 Population Greater than 20,000[1]

City	Year 2011 Population	County(ies)	City	Year 2011 Population	County(ies)
Dallas	1,216,203	Collin, Dallas, Denton, Rockwall	Haltom City	42,930	Tarrant
Fort Worth	761,149	Denton, Parker, Tarrant, Wise	Keller	40,846	Tarrant
Arlington	369,822	Tarrant	Sherman	39,171	Grayson
Plano	267,107	Collin, Denton	Rockwall	38,958	Rockwall
Garland	229,202	Collin, Dallas, Rockwall	Coppell	38,953	Dallas, Denton
Irving	220,259	Dallas	Duncanville	38,918	Dallas
Grand Prairie	179,630	Dallas, Ellis, Tarrant	Burleson	37,802	Tarrant, Johnson
Mesquite	141,407	Dallas, Kaufman	Hurst	37,625	Tarrant
McKinney	137,115	Collin	The Colony	37,597	Denton
Frisco	123,873	Collin, Denton	Lancaster	37,078	Dallas
Carrollton	121,894	Collin, Dallas, Denton	Waxahachie	30,554	Ellis
Denton	117,767	Denton	Farmers Branch	28,806	Dallas
Richardson	101,244	Collin, Dallas	Little Elm	27,216	Denton
Lewisville	98,200	Dallas, Denton	Southlake	27,149	Denton, Tarrant
Allen	87,629	Collin	Weatherford	25,880	Parker
Flower Mound	66,313	Denton, Tarrant	Balch Springs	24,253	Dallas
North Richland Hills	64,279	Tarrant	Corsicana	23,917	Navarro
Mansfield	58,279	Ellis, Tarrant, Johnson	Watauga	23,712	Tarrant
Rowlett	56,963	Dallas, Rockwall	Colleyville	23,268	Tarrant
Euless	52,025	Tarrant	University Park	23,200	Dallas
DeSoto	49,941	Dallas	Denison	22,709	Grayson
Bedford	47,369	Tarrant	Benbrook	21,504	Tarrant
Grapevine	47,220	Tarrant	Sachse	21,044	Collin, Dallas
Cedar Hill	45,902	Dallas, Ellis	Corinth	20,591	Denton
Wylie	43,288	Collin, Dallas, Rockwall	Saginaw	20,417	Tarrant

Average annual precipitation in Region C increases west to east from slightly more than 30 inches per year in western Jack County to more than 43 inches per year in the northeast corner of Fannin County [3]. Table 1.2 lists the 34 reservoirs in Region C with conservation storage over 5,000 acre-feet, all of which are shown in Figure I.1 (in the Introduction Section). These reservoirs and others outside of Region C provide most of the region's water supply. Reservoirs are necessary to provide a reliable surface water supply in this part of the state because of the wide variations in natural streamflow. Reservoir storage serves to capture high flows when they are available and save them for use during times of normal or low flow.

Figure 1.1 shows major and minor aquifers in Region C [4]. The most heavily used aquifer in Region C is the Trinity aquifer, which supplies most of the groundwater used in the region. The Carrizo-Wilcox aquifer also outcrops in Region C in Navarro, Freestone, and Henderson Counties. Minor aquifers in Region C include the Woodbine aquifer, the Nacatoch aquifer, and a small part of the Queen City aquifer.

1.3 Current Water Uses and Demand Centers in Region C

Water use in Region C has increased in recent years, primarily in response to increasing population. The historical record shows years of high use, including 1996, 1998, 1999, 2000, 2006, and 2011. High use years have historically been associated with dry weather, which causes higher municipal use due to increased outdoor water use (lawn watering). While this has historically been the case, the water use characteristics during dry years are now beginning to change in Region C due to recent major changes in conservation plans across the region. Many conservation plans have begun imposing permanent restrictions on outdoor watering, the most common restrictions being limiting the hours for lawn watering in the summer, limiting lawn watering to no more than twice per week, and prohibiting water waste.

The Texas Water Development Board categorizes water use as municipal, manufacturing, steam electric power generation, mining, irrigation, and livestock. Municipal use is by far the largest category in Region C, accounting for 88 percent of the total use in 2011. There is limited steam electric, mining, manufacturing, irrigation, and livestock use in Region C. Table 1.3 shows Region C water use by category for year 2011 and Region C use as a percent of statewide use. It is interesting to note that Region C, with 26 percent of Texas' population, had only 8.3 percent of the state's water use in 2011. This is primarily because Region C has very limited water use for irrigation, while irrigation use is more than 61 percent of the total use for the state as a whole.

Table 1.4 shows the 2011 water use in Region C by category and by county. About 88 percent of the current water use in Region C is for municipal supply, with mining use as the second largest category. The irrigation water use in Region C primarily represents the use of raw water for golf course irrigation, which TWDB classifies as irrigation, rather than municipal use. The year 2011 water use in Tarrant and Dallas Counties was 61 percent of the total Region C use. In the same year, these two counties had 65 percent of the region's population in 2011 and accounted for 74% percent of the employment of the region.

In addition to the consumptive water uses discussed above, water is used for recreation and other purposes in Region C. Reservoirs for which records of visitors are maintained (primarily Corps of Engineers lakes with recreational facilities) draw millions of visitors each year in Region C. In addition, smaller lakes and streams in the region draw many visitors for fishing, boating, swimming, and other water-related recreational activities. Water in streams and lakes is also important to fish and wildlife in the region.

1.4 Current Sources of Water Supply

Table 1.4 shows the groundwater and surface water use by county and category for year 2011 [(6)]. Table 1.4 demonstrates some interesting points about water use in Region C in the year 2011:

- Although groundwater provided only 10.4 percent of the overall water use in Region C, it provided 46 percent of the irrigation use, 21 percent of the livestock use, and 47 percent of the mining use.
- Groundwater provided the majority of the total water use in Cooke County and over 25 percent in Ellis, Fannin, Grayson, Henderson, Jack, Parker, and Wise Counties.
- Groundwater provided the majority of the municipal use in Cooke, Fannin, Freestone, Parker, and Wise Counties.
- Dallas and Tarrant Counties had 64 percent of the municipal water use in the region.
- Dallas and Tarrant Counties had 76 percent of the manufacturing water use in the region.
- Freestone County had almost 90 percent of the steam electric power water use in the region, with Tarrant County having the next highest steam electric power use at 5.5%.
- Dallas and Tarrant Counties had 44 percent of the irrigation use in the region.
- Denton, Freestone, Parker, Tarrant, and Wise Counties had 86 percent of the mining use in the region.
- Livestock use is widely spread throughout the region.

Table 1.2
Major Reservoirs in Region C (Over 5,000 Acre-Feet of Conservation Storage)

Reservoir	Basin	Stream	County(ies)	Permitted Conservation Storage (Acre-Feet)	Owner	Water Right Holder(s)
Moss	Red	Fish Creek	Cooke	23,210	Gainesville	Gainesville
Texoma	Red	Red River	Grayson, Cooke	2,722,000	Corps of Engineers	Red River Authority, Greater Texoma UA, Denison, North Texas MWD, Luminant
Randell	Red	Unnamed Trib. Shawnee Creek	Grayson	5,400	Denison	Denison
Valley	Red	Sand Creek	Fannin, Grayson	15,000	Luminant	Luminant
Bonham	Red	Timber Creek	Fannin	13,000	Bonham MWA	Bonham
Coffee Mill	Red	Coffee Mill Creek	Fannin	8,000	USDA	U.S. Department of Agriculture
Kiowa	Trinity	Indian Creek	Cooke	7,000	Lake Kiowa POA Inc.	Lake Kiowa Property Owners Association, Inc.
Ray Roberts	Trinity	Elm Fork Trinity River	Denton, Cooke, Grayson	799,600	Corps of Engineers	Dallas and Denton
Lost Creek	Trinity	Lost Creek	Jack	11,961	Jacksboro	Jacksboro
Bridgeport	Trinity	West Fork Trinity River	Wise, Jack	387,000	TRWD	Tarrant Regional Water District
Lewisville	Trinity	Elm Fork Trinity River	Denton	618,400	Corps of Engineers	Dallas and Denton
Lavon	Trinity	East Fork Trinity River	Collin	380,000	Corps of Engineers	North Texas MWD
Weatherford	Trinity	Clear Fork Trinity River	Parker	19,470	Weatherford	Weatherford
Grapevine	Trinity	Denton Creek	Tarrant, Denton	161,250	Corps of Engineers	Dallas County Park Cities MUD, Dallas, Grapevine
Eagle Mountain	Trinity	West Fork Trinity River	Tarrant, Wise	210,000	TRWD	Tarrant Regional Water District
Worth	Trinity	West Fork Trinity River	Tarrant	38,124	Fort Worth	Fort Worth
Benbrook	Trinity	Clear Fork Trinity River	Tarrant	72,500	Corps of Engineers	Tarrant Regional Water District, Benbrook WSA
Arlington	Trinity	Village Creek	Tarrant	45,710	Arlington	Arlington and Luminant
Joe Pool	Trinity	Mountain Creek	Dallas, Tarrant	176,900	Corps of Engineers	Trinity River Authority
Mountain Creek	Trinity	Mountain Creek	Dallas	22 ,840	Luminant	Luminant
North	Trinity	South Fork Grapevine Creek	Dallas	17,100	Luminant	Luminant
White Rock	Trinity	White Rock Creek	Dallas	21,345	Dallas	Dallas

Table 1.2, Continued

Reservoir	Basin	Stream	County(ies)	Permitted Conservation Storage (Acre-Feet)	Owner	Water Right Holder(s)
Ray Hubbard	Trinity	Elm Fork Trinity River	Dallas, Kaufman, Rockwall	490,000	Dallas	Dallas
Terrell	Trinity	Muddy Cedar Creek	Kaufman	8,712	Terrell	Terrell
Bardwell	Trinity	Waxahachie Creek	Ellis	54,900	Corps of Engineers	Trinity River Authority
Waxahachie	Trinity	Waxahachie Creek	Ellis	13,500	Ellis Co. WCID#1	Ellis Co. WCID#1
Cedar Creek	Trinity	Cedar Creek	Henderson, Kaufman	678,900	TRWD	Tarrant Regional Water District
Forest Grove	Trinity	Caney Creek	Henderson	20,038	Luminant	Luminant
Trinidad	Trinity	Off-channel	Henderson	6,200	Luminant	Luminant
Navarro Mills	Trinity	Richland Creek	Navarro	63,300	Corps of Engineers	Trinity River Authority
Halbert	Trinity	Elm Creek	Navarro	7,357	Corsicana	Corsicana
Richland-Chambers	Trinity	Richland Creek	Freestone, Navarro	1,135,000	TRWD	Tarrant Regional Water District, Corsicana
Fairfield	Trinity	Big Brown Creek	Freestone	50,600	Luminant	Luminant
Mineral Wells	Brazos	Rock Creek	Parker	7,065	Mineral Wells	Mineral Wells

Note: Data are from TCEQ water rights list [5] and other sources.

Figure 1.1
Major and Minor Aquifers in Region C

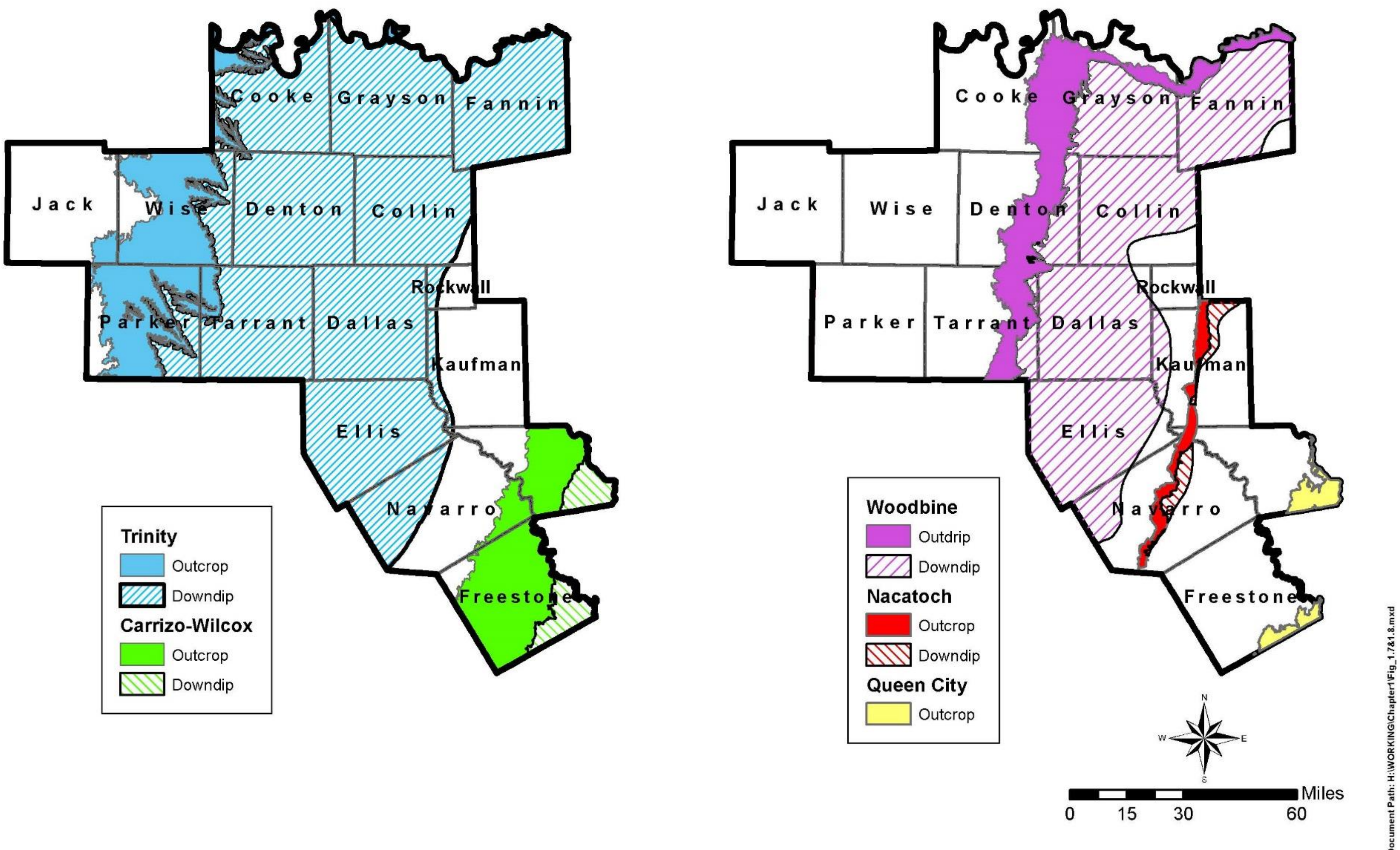


Table 1.3
Year 2011 Water Use by Category by County (Acre-Feet)

County	Municipal	Manu-facturing	Mining	Steam Electric (Power)	Irrigation	Livestock	Total
Collin	189,662	1,005	0	40	2,618	1,235	194,560
Cooke	5,856	104	1,664	0	1,194	1,409	10,227
Dallas	490,812	18,962	1,722	912	11,837	898	525,143
Denton	136,887	338	4,510	23	3,284	798	145,840
Ellis	28,837	4,361	56	0	1,499	1,596	36,349
Fannin	5,221	0	574	0	6,756	1,413	13,964
Freestone	3,528	0	6,700	30,847	683	1,337	43,095
Grayson	25,497	1,001	79	0	4,418	1,277	32,272
Henderson [b]	9,630	705	150	132	159	783	11,559
Jack	1,249	1	902	0	145	869	3,166
Kaufman	15,150	724	195	0	157	2,193	18,419
Navarro	9,991	507	1,143	0	70	2,280	13,991
Parker	17,141	88	3,187	604	262	2,289	23,571
Rockwall	15,500	5	0	0	250	104	15,859
Tarrant	365,080	9,828	11,357	1,911	6,255	736	395,167
Wise	8,710	232	14,010	0	1,468	1,284	25,704
Total Region C	**1,328,751**	**37,861**	**46,249**	**34,469**	**41,055**	**20,501**	**1,508,886**
Texas Total							**18,093,827**
Region C Total Water Use as a Percent of Statewide Water Use							**8.3%**

Notes: a. Data are from the Texas Water Development Board [6].
b. Data for Henderson County include only the portion of county in Region C.

1.4.1 Surface Water Sources

Most of the surface water supply in Region C comes from major reservoirs. Table 1.5 lists the permitted conservation storage, and the permitted diversion for major reservoirs (over 5,000 acre-feet of conservation storage) in the region. Another major source of supply in Region C is surface water imported from other regions. Table 1.6 lists currently permitted imports of water to Region C from other regions. (No special permit is required if importation from another region does not involve interbasin transfers, but all significant imports to Region C, except for TRA's upstream sale from Lake Livingston, currently involve interbasin transfers and thus require interbasin transfer permits.) Figure 1.1 shows the surface water reservoirs that provide these imports. There is also small-scale importation of treated water in parts of the region, where suppliers purchase water that originates in other regions.

Table 1.4
Sources of Water Supply by County by Category in 2011 for Region C (Acre-Feet)

County	Water Type	Municipal	Manu-facturing	Steam Electric	Irrigation	Mining	Livestock	Total
Collin	Ground	7,525	322	0	1,068	0	62	8,977
	Surface	182,137	683	40	1,550	0	1,173	185,583
	Total	189,662	1,005	40	2,618	0	1,235	194,560
Cooke	Ground	5,266	104	0	609	793	211	6,983
	Surface	591	0	0	585	871	1,198	3,245
	Total	5,857	104	0	1,194	1,664	1,409	10,228
Dallas	Ground	4,664	762	0	4,337	452	763	10,978
	Surface	486,148	18,200	912	7,500	1,270	135	514,165
	Total	490,812	18,962	912	11,837	1,722	898	525,143
Denton	Ground	16,986	1	0	2,534	1,663	239	21,423
	Surface	119,901	337	23	750	2,847	559	124,417
	Total	136,887	338	23	3,284	4,510	798	145,840
Ellis	Ground	9,157	2,069	0	1,499	22	32	12,779
	Surface	19,680	2,292	0	0	34	1,564	23,570
	Total	28,837	4,361	0	1,499	56	1,596	36,349
Fannin	Ground	3,565	0	0	743	0	1,272	5,580
	Surface	1,655	0	0	6,013	574	141	8,383
	Total	5,220	0	0	6,756	574	1,413	13,963
Freestone	Ground	3,480	0	152	613	6,327	134	10,706
	Surface	48	0	30,695	70	373	1,203	32,389
	Total	3,528	0	30,847	683	6,700	1,337	43,095
Grayson	Ground	10,935	694	0	3,668	22	319	15,638
	Surface	14,562	306	0	750	57	958	16,633
	Total	25,497	1,000	0	4,418	79	1,277	32,271
Henderson [b]	Ground	3,393	643	0	31	48	313	4,428
	Surface	6,237	62	132	128	102	470	7,131
	Total	9,630	705	132	159	150	783	11,559
Jack	Ground	545	0	0	55	448	130	1,178
	Surface	704	1	0	90	454	739	1,988
	Total	1,249	1	0	145	902	869	3,166

County	Water Type	Municipal	Manu-facturing	Steam Electric	Irrigation	Mining	Live-stock	Total
Kaufman	Ground	2,344	487	0	143	49	110	3,133
	Surface	12,806	237	0	14	146	2,083	15,286
	Total	15,150	724	0	157	195	2,193	18,419
Navarro	Ground	1,219	0	0	70	318	114	1,721
	Surface	8,772	507	0	0	825	2,166	12,270
	Total	9,991	507	0	70	1,143	2,280	13,991
Parker	Ground	9,038	25	0	185	989	229	10,466
	Surface	8,102	62	604	77	2,198	2,060	13,103
	Total	17,140	87	604	262	3,187	2,289	23,569
Rockwall	Ground	144	0	0	0	0	1	145
	Surface	15,356	5	0	250	0	103	15,714
	Total	15,500	5	0	250	0	104	15,859
Tarrant	Ground	23,559	256	0	1,755	4,547	110	30,227
	Surface	341,522	9,572	1,911	4,500	6,810	626	364,941
	Total	365,081	9,828	1,911	6,255	11,357	736	395,168
Wise	Ground	4,873	162	0	1,458	6,091	257	12,841
	Surface	3,837	71	0	10	7,919	1,027	12,864
	Total	8,710	233	0	1,468	14,010	1,284	25,705
Region C	Ground	106,693	5,525	152	18,768	21,769	4,296	157,203
	Surface	1,222,058	32,335	34,317	22,287	24,480	16,205	1,351,682
	Total	1,328,751	37,860	34,469	41,055	46,249	20,501	1,508,885

Notes: a. Data are from the Texas Water Development Board [6].
b. Data for Henderson County include only the portion of Henderson County within Region C.

Table 1.5
Water Rights, Storage, and Diversion for Major Reservoirs in Region C

Reservoir	County(ies)	Water Right Number(s) [a]	Permitted Conservation Storage [b] (Acre-Feet)	Permitted Diversion [b] (Acre-Feet/Year)
Moss	Cooke	4881	23,210	7,740
Texoma	Grayson, Cooke	4301B, 4301C, 4898, 4899, 4901, 4900, 5003	2,915,365	306,600
Randell	Grayson	4901	5,400	5,280
Valley	Fannin, Grayson	4900	15,000	16,400
Bonham	Fannin	4925	13,000	5,340
Coffee Mill	Fannin	4915	8,000	0
Kiowa	Cooke	2334A, 2334C	7,000	234
Ray Roberts	Denton, Cooke, Grayson	2335A, 2455B	799,600	799,600
Lewisville	Denton	2348,2456	618,400	608,400
Lost Creek	Jack	3313A	11,961	1,440
Bridgeport	Wise, Jack	3808B,	387,000	17,000[c]
Eagle Mountain	Tarrant, Wise	3809	210,000	159,600[f]
Lavon	Collin	2410G	443,800	118,670[d]
Weatherford	Parker	3356	19,470	5,220[e]
Grapevine	Tarrant, Denton	2362A, 2363A, 2458C	161,250	160,750
Benbrook	Tarrant	5157A	72,500	6,833
Arlington	Tarrant	3391	45,710	23,120
Joe Pool	Dallas, Tarrant	3404C	176,900	17,000[d]
Mountain Creek	Dallas	3408	22,840	6,400
White Rock	Dallas	2461B	21,345	8,703
Ray Hubbard	Dallas, Kaufman, Rockwall	2462H	490,000	89,700
Terrell	Kaufman	4972	8,712	6,000
Bardwell	Ellis	5021A	54,900	9,600[d]
Waxahachie	Ellis	5018	13,500	3,570
Cedar Creek	Henderson, Kaufman	4976C	678,900	175,000[d]
Teague City Lake	Freestone	5291	1,160	605
Clark	Ellis	5019	1,549	450

Reservoir	County(ies)	Water Right Number(s) [a]	Permitted Conservation Storage [b] (Acre-Feet)	Permitted Diversion [b] (Acre-Feet/Year)
Forest Grove	Henderson	4983	20,038	9,500[h]
Trinidad	Henderson	4970	6,200	4,000
Navarro Mills	Navarro	4992	63,300	19,400
Richland-Chambers	Freestone, Navarro	5030, 5035C	1,135,000	223,650[d]
Fairfield	Freestone	5040	50,600	14,150
Mineral Wells	Parker	4039	7,065	2,520
Muenster	Cooke	2323	4,700	500

Notes: a. Water rights numbers are Certificate of Adjudication numbers. For permits issued since adjudication, they are application numbers.

b. Permitted conservation storage and permitted diversion are from TCEQ permits [(5)].

c. Release of 78,000 acre-feet per year for diversion and use from Eagle Mountain Lake is also authorized.

d. Permitted diversion does not include reuse.

e. Diversion does not include 59,400 acre-feet per year of non-consumptive industrial use.

f. Permitted diversion includes water releases from Lake Bridgeport.

g. Additional use (beyond the water right) is based on purchased water.

h. Permitted diversion does not include non-consumptive use.

Table 1.6
Permitted Importation of Surface Water to Region C

Region C Supplier	Source	Source Region	Source Basin	Destina-tion Basin	Permitted Amount (Acre-Feet/Year)	Raw or Treated	Status
North Texas MWD	Chapman Lake [a]	D	Sulphur	Trinity	57,214	Raw	Operating
Irving	Chapman Lake [a]	D	Sulphur	Trinity	54,000	Raw	Operating
Upper Trinity RWD	Chapman Lake [a]	D	Sulphur	Trinity	16,106	Raw	Operating
Dallas	Lake Tawakoni	D	Sabine	Trinity	184,600	Raw	Operating
Dallas	Lake Fork Reservoir	D	Sabine	Trinity	120,000	Raw	Operating
Dallas	Lake Palestine	I	Neches	Trinity	114,337	Raw	Not Yet Developed
Athens [b]	Lake Athens	I	Neches	Trinity	5,477	Treated	Operating
North Texas MWD	Lake Tawakoni	D	Sabine	Trinity	11,098	Raw	Operating
North Texas MWD	Lake Tawakoni and Lake Fork	D	Sabine	Trinity	40,000[d]	Raw	Operating
TXU Big Brown Plant	Lake Livingston [c]	H	Trinity	Trinity	20,000	Raw	Operating

Notes:
a. Chapman Lake was formerly Cooper Lake.
b. Most of Athens is in the Trinity Basin.
c. Use is an upstream diversion based on Lake Livingston water right. Contract allows 20,000 acre per year, with a maximum of 48,000 acre-feet over 3 years.
d. This is an interim supply.

1.4.2 Groundwater Sources

Table 1.7 lists the 2011 groundwater pumping by county and aquifer for Region C [(6)]. (Note that the pumping totals do not match use totals given in Table 1.4. The Texas Water Development Board supplied both sets of data. The discrepancy may be due to water that is pumped in one county and used in another.) The Trinity aquifer is by far the largest source of groundwater in Region C, providing 41 percent of the total groundwater pumped in 2011. (The Trinity aquifer is sometimes called the Trinity Sands and includes the Antlers, Twin Mountain, Glen Rose, and Paluxy formations [(6)].) The Woodbine and Carrizo-Wilcox aquifers provided 20.8 and 6.6 percent of the year 2011 totals, respectively. The remaining 31 percent came from the Nacatoch, Queen City, Blossom, Unknown/Other aquifers, and undifferentiated aquifers. The counties in which there are known to be several locally undifferentiated formations are Fannin (Red River Alluvium), Jack, and Parker. There may be other counties in which this is the case, but it is believed that the large 2011 use numbers from the unknown, other, and undifferentiated aquifers are likely to be from one of the named aquifers, but were not classified as such in the TWDB data. Groundwater pumping was highest (over 10,000 acre-feet) in Dallas, Denton, Ellis, Grayson, Parker, Tarrant, and Wise Counties. These seven counties had 72.5 percent of the region's total groundwater pumping in 2011.

Table 1.7
Year 2011 Groundwater Pumping by County and Aquifer in Region C (Acre-feet)

County	Trinity Aquifer	Woodbine Aquifer	Carrizo-Wilcox Aquifer	Naca-toch Aquifer	Queen City Aquifer	Blossom Aquifer	Other/ Undesig-nated Aquifer	Un-known	Total
Collin	3,171	4,091	0	0	0	0	1,093	0	**8,355**
Cooke	4,375	338	0	0	0	0	1,361	793	**6,867**
Dallas	3,356	5,273	0	0	0	0	1,898	452	**10,979**
Denton	9,404	5,588	0	0	0	0	4,966	1,663	**21,621**
Ellis	4,720	2,807	0	0	0	0	6,025	22	**13,574**
Fannin	215	4,156	0	0	0	450	1,001	0	**5,822**
Freestone	0	0	3,458	0	58	0	1,016	3,370	**7,902**
Grayson	6,635	6,796	0	0	0	0	2,202	22	**15,655**
Henderson[(a)]	0	0	6,708	14	697	0	496	52	**7,967**
Jack	60	0	0	0	0	0	689	448	**1,197**
Kaufman	0	0	0	266	0	0	2,417	49	**2,732**
Navarro	0	0	65	215	0	0	888	315	**1,483**
Parker	7,715	0	0	0	0	0	1,649	989	**10,353**
Rockwall	0	0	0	0	0	0	124	0	**124**
Tarrant	18,441	3,114	0	0	0	0	4,164	4,109	**29,828**
Wise	5,602	0	0	0	0	0	814	3,661	**10,077**
Total	**63,694**	**32,163**	**10,231**	**495**	**755**	**450**	**30,803**	**15,945**	**154,536**

[(a)] Includes all of Henderson County

Table 1.8 compares the modeled available groundwater supplies for the Trinity and Woodbine aquifers in Region C to 2011 use. The "modeled available groundwater" represents the amount of groundwater that can be pumped while maintaining stated "desired future conditions" in an aquifer. For Region C, the desired future conditions for the Trinity and Woodbine aquifer were set by Groundwater Management Area 8, a consortium of groundwater districts in North-Central and North Texas, covering most Region C and most of the area overlying the Northern Trinity and Woodbine aquifers. Once the desired future conditions were established, the Texas Water Development Board determined the modeled available water that could be pumped while meeting those conditions. For planning purposes, TWDB regulations governing regional planning require that groundwater use be no more than the modeled available groundwater.

Table 1.8 shows that current groundwater use (as of 2011) exceeds the modeled available groundwater in certain Region C counties and aquifers. Pumping from the Trinity and Woodbine aquifers in Collin County, the Woodbine aquifer in Cooke, Dallas, Denton, Fannin, and Tarrant Counties, and the Trinity aquifer in Ellis and Jack Counties exceeded the modeled available groundwater.

In Texas, groundwater conservation districts (GCD) manage groundwater conservation, preservation, protection, recharge, and waste prevention within their borders. Typical GCD responsibilities include permitting wells, developing management plans, and adopting rules to implement management plans. Seven GCDs exist within the Region C boundaries. These GCDs are shown on Figure 1.2. The seven GCDs include:

- Mid-East Texas GCD, which includes Freestone County,
- Neches and Trinity Valley GCD, which includes Henderson County,
- Northern Trinity GCD, which comprises only Tarrant County,
- Upper Trinity GCD, which includes Parker and Wise Counties, as well as Montague County in Region B and Hood County in Region G,
- Prairielands GCD, which includes Ellis County,
- North Texas GCD, which is comprised of Collin, Cooke, and Denton Counties, and
- Red River GCD, which is comprised of Grayson and Fannin Counties.

A portion of Region C is located within the North-Central Texas Trinity and Woodbine Aquifers Priority Groundwater Management Area (PGMA). Figure 1.3 is a map of this and other PGMAs in Texas. The above mentioned GCDs cover all counties in North-Central Texas Trinity and Woodbine Aquifers PGMA except Dallas County. Section 35.019 of the Texas Water Code allows the commissioners court of a county in a PGMA not covered by a GDC to adopt water availability requirements. As of this time, to the best knowledge of Region C, Dallas County commissioner's court has not promulgated any groundwater regulations or availability values.

Table 1.8
Comparison of Year 2011 Estimated Groundwater Pumping to Modeled Available Groundwater by Aquifer (Acre-Feet)

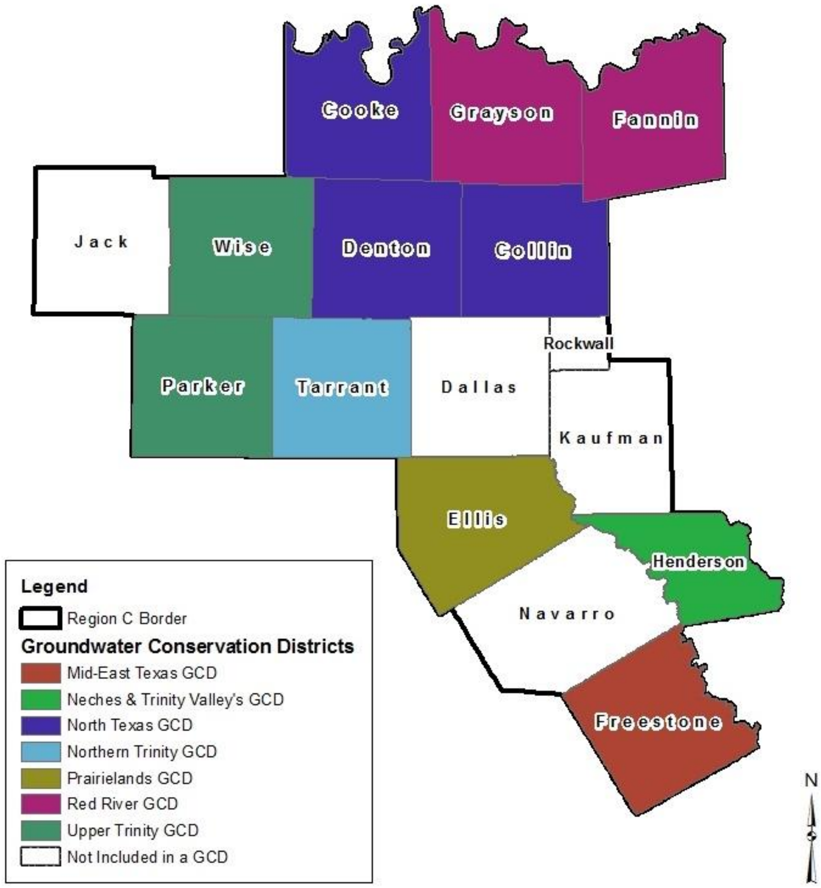
County	Trinity 2011 Pumping	Trinity Modeled Available Groundwater(7)	Trinity Over-Pumping	Woodbine 2011 Pumping	Woodbine Modeled Available Groundwater(7)	Woodbine Over-Pumping
Collin	3,171	2,104	1,067	4,091	2,509	1,582
Cooke	4,375	6,850		338	154	184
Dallas	3,356	5,458		5,273	2,313	2,960
Denton	9,404	19,333		5,588	4,126	1,462
Ellis	4,720	3,959	761	2,807	5,441	
Fannin	215	700		4,156	3,297	859
Freestone	0	0		0	0	
Grayson	6,635	9,400		6,796	12,087	
Henderson	0	0		0	0	
Jack	60	0	60	0	0	
Kaufman	0	1,181		0	200	
Navarro	0	1,873		0	300	
Parker	7,715	15,248		0	0	
Rockwall	0	958		0	144	
Tarrant	18,441	18,747		3,114	632	2,482
Wise	5,602	9,282		0	0	
Total	**63,694**	**95,093**	**1,888**	**32,163**	**31,203**	**9,529**

Notes: a. Pumping data and estimates are from Texas Water Development Board. (6)

1.4.3 Water Reclamation

About half of the water used for municipal supply in Region C is discharged as treated effluent from wastewater treatment plants after use, making wastewater reclamation and reuse a potentially significant source of additional water supply. There are currently a number of water reclamation direct reuse projects in Region C that reuse highly treated wastewater for non-potable uses such as the irrigation of golf courses, or industrial or mining uses. There are also a number of large scale indirect reuse projects, notably TRWD and NTWMD wetlands reuse projects. In fact, currently authorized reuse makes up over 10 percent of the overall available supply in Region C

Figure 1.2
Groundwater Conservation Districts in Region C

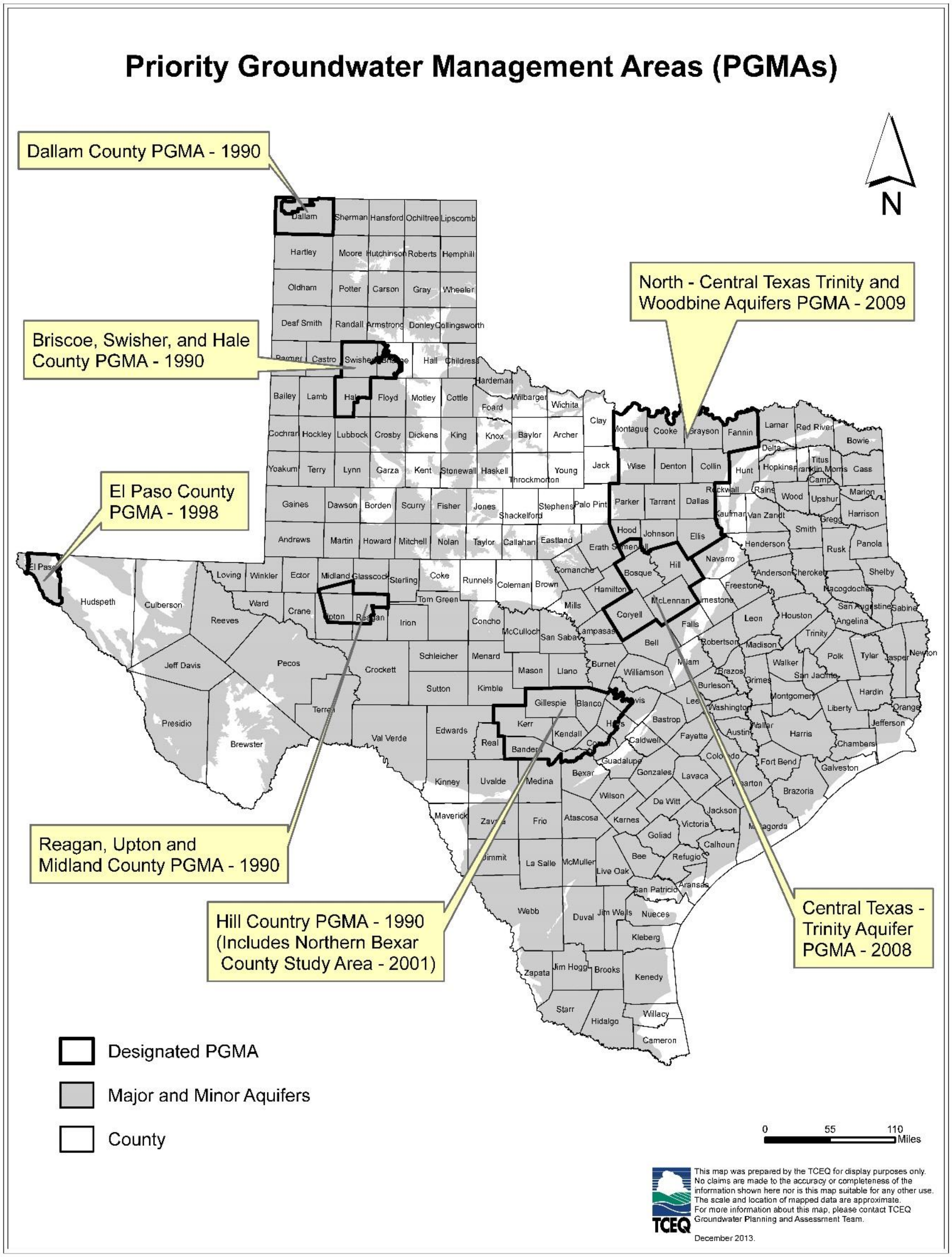


In addition to direct and indirect reuse projects, there are sizable return flows of treated wastewater upstream from many Region C reservoirs. If a reservoir's water rights exceed its firm yield without return flows, as is the case for many Region C reservoirs, return flows will increase the reliable supply from the reservoir. If the reservoir's water rights do not exceed its firm yield, a water right must be obtained to allow indirect reuse of return flows. Many Region C suppliers have obtained or plan to obtain water right permits for these return flows.

1.4.4 Springs in Region C

There are no springs in Region C that are currently used as a significant source of water supply. Springs are further discussed in Section 1.10 of this report (Agricultural and Natural Resources in Region C).

Figure 1.3
Priority Groundwater Management Areas (PGMAs) in Texas



1.5 Water Providers in Region C

Water providers in Region C include regional wholesale water providers such as river authorities, larger water districts, and cities with large wholesale customer bases; local wholesale water providers such as smaller water districts and some cities, and retail suppliers (cities and towns, water supply corporations, special utility districts, and private water companies). Cities and towns provide most of the retail water service in Region C, with significant contributions from water districts, water supply corporations, and special utility districts.

1.5.1 Wholesale Water Providers (WWPs)

The Texas Water Development Board defines the term wholesale water provider (WWP) as follows: "[A WWP is] any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last Regional Water Plan. The Planning Groups shall [also] include as wholesale water providers other persons and entities that enter or that the Planning Group expects to enter contracts to sell more than 1,000 acre-feet of water wholesale during the period covered by the plan."

Table 1.9 lists the 41 entities that qualify as Region C wholesale water providers (21 cities, 3 river authorities, and 17 water districts). Thirteen of the wholesale water providers provide a large amount of wholesale supplies to several customers and are discussed below as regional wholesale water providers. The remaining 28 have fewer customers and are discussed as local wholesale water providers. Appendix H includes a list of each WWP's customers.

1.5.2 Regional Wholesale Water Providers

There are thirteen wholesale water providers that serve a large number of customers and/or provide large wholesale supplies in Region C and are called regional wholesale water providers: the City of Dallas (Dallas Water Utilities), Tarrant Regional Water District, North Texas Municipal Water District, the City of Fort Worth, Sabine River Authority, Trinity River Authority, Upper Neches River Municipal Water Authority, Upper Trinity Regional Water District, Sulphur River Water District, Dallas County Park Cities Municipal Utility District, Greater Texoma Utility Authority, the City of Corsicana, and the Sulphur River Basin Authority (future provider).

City of Dallas (Dallas Water Utilities, or DWU). Year 2011 water sales by Dallas Water Utilities totaled 392,915 acre-feet and include retail and wholesale sales. Dallas Water Utilities currently obtains its water supplies from Lake Ray Hubbard, Lake Tawakoni, Grapevine Lake, the Lake Ray Roberts/Lewisville/Elm

Table 1.9
Region C Wholesale Water Providers

Wholesale Water Provider	Year 2011 Total Sales [b] (Acre-Feet)
Argyle WSC	1,203
Arlington	72,466
Athens Municipal Water Authority	2,603
Corsicana	10,337[c]
Cross Timbers WSC (formerly Bartonville WSC)	1,133
Dallas (Dallas Water Utilities)	392,915
Dallas County Park Cities MUD	14,152
Denison	8,785
Denton	32,155
East Cedar Creek FWSD	1,357
Ennis	4,673
Forney	5,056
Fort Worth	231,796
Gainesville	2,619
Garland	41,080
Grand Prairie	28,752
Greater Texoma Utility Authority	4,643[c]
Lake Cities MUA	1,933
Mansfield	15,381
Midlothian	9,080
Mustang SUD	1,172
North Richland Hills	15,406
North Texas Municipal Water District	320,482[c]
Princeton	1,442
Rockett SUD	4,226
Rockwall	12,321
Sabine River Authority	unavailable
Seagoville	2,157
Sherman	11,459
Sulphur River Basin Authority	0
Sulphur River Municipal Water District (located in Region D) [c]	16,694[a]
Tarrant Regional Water District	399,587[c]
Terrell	4,321
Trinity River Authority	73,204[c]

Table 1.9, continued

Wholesale Water Provider	Year 2011 Wholesale Sales [b] (Acre-Feet)
Upper Neches River Municipal Water Authority (located in Region I)	21,328[c]
Upper Trinity Regional Water District	27,604[c]
Walnut Creek SUD	2,211
Waxahachie	7,197
Weatherford	6,819
West Cedar Creek MUD	1,404
Wise County WSD	1,739

a. Value provided by Region D consultant

b. Includes wholesale and retail sales

c. Value provided by WWP

Fork system, and Lake Fork. Dallas Water Utilities has contracted with the Upper Neches River Municipal Water Authority to secure water from Lake Palestine, but Lake Palestine is not currently connected to DWU's system. Currently, DWU has the capacity to treat up to 900 million gallons of water per day (mgd) with another 100 mgd of treatment capacity under construction. DWU supplies treated and raw water to wholesale customers in Dallas, Collin, Denton, Ellis, and Kaufman Counties.

Tarrant Regional Water District (TRWD). Year 2011 sales by the Tarrant Regional Water District totaled 399,587 acre-feet. TRWD supplies raw water to customers in Tarrant County, eight other counties in Region C, and Johnson County in the Brazos G Region. TRWD owns and operates Lake Bridgeport, Eagle Mountain Lake, Cedar Creek Reservoir, and Richland-Chambers Reservoir. The district's water supply system also includes Lake Arlington (owned by Arlington), Lake Worth (owned by Fort Worth), and Benbrook Lake (owned by the Corps of Engineers, with TRWD holding water rights), a major reuse project, and a substantial water transmission system. The district also has commitments to supply water through the Trinity River Authority to users in Ellis County.

North Texas Municipal Water District (NTMWD). Year 2011 sales by the North Texas Municipal Water District totaled 320,482 acre-feet. NTMWD supplies treated water to customers in suburban communities north and east of Dallas. The district obtains raw water from water rights in Lake Lavon, Lake Texoma, and Chapman Lake, all of which are owned and operated by the Corps of Engineers. NTMWD also obtains water from Lake Tawakoni and Lake Fork through the Sabine River Authority (SRA). NTMWD also has a permit to reuse treated wastewater effluent from its Wilson Creek Wastewater Treatment Plant and diversions from its East Fork Water Supply Project. This supply is blended with other freshwater supplies in Lake Lavon. In addition to providing treated water, the NTMWD also owns and/or operates a number of wastewater treatment plants in Region C.

City of Fort Worth. Wholesale and retail water sales by the City of Fort Worth totaled 231,796 acre-feet in 2011. The City of Fort Worth purchases all of its water from Tarrant Regional Water District and has water treatment plants with combined current capacity to treat 497 million gallons of water per day. The City of Fort Worth sells wholesale treated water to other water suppliers, mostly located in Tarrant County.

Sabine River Authority (SRA). The Sabine River Authority is primarily located in Region D (the North East Texas Region) and Region I (the East Texas Region). However, SRA has contracts to supply water to several entities in Region C, the largest contracts being with Dallas Water Utilities. SRA has water supplies in Lake Fork Reservoir, Lake Tawakoni, Toledo Bend Reservoir, and the Sabine River Basin canal system. SRA has contracts with Region C entities for up to 341,584 acre-feet per year.

Trinity River Authority (TRA). The Trinity River Authority serves as a regional wholesale water supplier through a number of projects in Region C:

- TRA holds water rights in Joe Pool Lake, Navarro Mills Lake, and Bardwell Lake, all owned and operated by the Corps of Engineers. TRA sells raw water from these lakes for use in Region C. (TRA has contracts to sell Joe Pool Lake water to Midlothian, Duncanville, Cedar Hill, and Grand Prairie. TRA sells water from Navarro Mills Lake to the City of Corsicana and from Bardwell Lake to Ennis and Waxahachie.)
- TRA sells raw water to Luminant for use in the Big Brown Steam Electric Station on Lake Fairfield. This water is diverted from the Trinity River under water rights held by TRA in Lake Livingston, which is downstream, in Region H.
- TRA has a regional treated water system in northeast Tarrant County, which treats raw water delivered by the Tarrant Regional Water District system through Lake Arlington and sells treated water to cities. This system is known as the Tarrant County Water Supply Project.
- TRA has a commitment to sell raw water provided by the Tarrant Regional Water District to water suppliers in Ellis County in the future and is now selling water to some Ellis County entities. This system is known as the Ellis County Water Supply Project.

The 2011 sales by Trinity River Authority in Region C totaled 73,204 acre-feet. In addition to its raw and treated water sales, TRA operates a number of regional wastewater treatment projects in Region C.

Upper Neches River Municipal Water Authority (UNRMWA). The Upper Neches River Municipal Water Authority is located in Region I (the East Texas Region), where it owns and operates Lake Palestine.

UNRMWA has contracted to supply up to 114,937 acre-feet per year to Dallas Water Utilities in Region C, but the facilities to connect the supplies have not yet been constructed.

Upper Trinity Regional Water District (UTRWD). The 2011 water sales by the Upper Trinity Regional Water District totaled 27,604 acre-feet. UTRWD operates a regional treated water supply system in Denton County, which is a rapidly growing area. The UTRWD currently has a peak water treatment capacity of 90 million gallons per day.

UTRWD has a contract with the City of Commerce to divert up to 16,106 acre-feet per year of raw water from Chapman Lake in the Sulphur River Basin. UTRWD cooperates with the City of Irving to bring that water to Lewisville Lake. UTRWD also has contracts to buy raw water from Dallas and Denton and has an indirect reuse permit. UTRWD also has a Texas water right for Ralph Hall Lake, a proposed lake in Fannin County. In addition to its water supply activities, UTRWD provides regional wastewater treatment services in Denton County.

Sulphur River Municipal Water District (SRWD). The Sulphur River Municipal Water District is located in Region D (the North East Texas Region) and has water rights in Chapman Lake on the South Fork of the Sulphur River. The SRWD sells raw water to the Upper Trinity Regional Water District in Region C.

Dallas County Park Cities Municipal Utility District (PCMUD). The Dallas County Park Cities Municipal Utility District has a water right to divert 50,000 acre-feet per year from Grapevine Lake, but its share of the firm yield from the lake is considerably less than the water right. According to TWDB use records, the PCMUD diverted 14,152 acre-feet in 2010. The district operates its own water treatment plant and provides treated water to Highland Park and University Park. The district also sells raw water to the City of Grapevine. The raw water sold to Grapevine originates from the City of Grapevine's wastewater treatment plant discharges into Lake Grapevine.

Greater Texoma Utility Authority (GTUA). The Greater Texoma Utility Authority has water rights for 83,200 acre-feet per year from Lake Texoma and has contracts to provide raw water to water suppliers in Grayson and Cooke Counties. GTUA currently provides raw water to Sherman, which operates a desalination and treatment plant. In 2011, the GTUA diverted 4,643 acre-feet of raw water from Lake Texoma. The authority also operates wastewater treatment plants for several communities in the Red River Basin.

City of Corsicana. The year 2011 wholesale and retail water sales by the City of Corsicana totaled 10,337 acre-feet. The City of Corsicana supplies treated surface water to a significant portion of Navarro County. Corsicana has water rights in Lake Halbert and Richland-Chambers Reservoir and has a contract to purchase water from Navarro Mills Lake from the Trinity River Authority. Corsicana currently uses water from Lake Halbert, Navarro Mills Lake, and Richland-Chambers Reservoir. Corsicana has the capacity to treat up to 4 million gallons per day at their Lake Halbert water treatment plant and up to 20 million gallons per day at their Navarro Mills treatment plant.

Sulphur River Basin Authority (SRBA). SRBA does not currently provide water supply to entities in Region C, but it is anticipated that SRBA will provide water from the Sulphur Basin (Sulphur Basin Supplies Strategy outlined in Section 5B.3) to North Texas Municipal Water District, Tarrant Regional Water District, and Upper Trinity Regional Water District and potentially supply water to Dallas and Irving. At the request of SRBA, the Region C Water Planning Group voted to designate SRBA as a WWP on September 28, 2015.

1.5.3 Local Wholesale Water Providers

Twenty-eight other entities qualify as local wholesale water providers in Region C. These entities provide or are expected to provide over 1,000 acre-feet of wholesale water per year. These entities have been noted as "local" because they supply only a few customers in their immediate area. Table 1.9 includes the local wholesale water providers and their total year 2011 water sales.

1.5.4 Retail Water Suppliers

Cities, towns, water supply corporations, and special utility districts provide most of the retail water service in Region C. The Texas Water Development Board developed the term "water user group" (WUG) to identify entities that regional water planning groups must include in their plans. The TWDB definition for a water user group states that a WUG is defined as one of the following:

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

- Mining
- Irrigation
- Livestock.

Table 1.10 shows the number of WUGs for each county in Region C.

Table 1.10
Region C Number of Water User Groups by County

County	Municipal	Non- Municipal	Total
Collin	41	4	45
Cooke	10	4	14
Dallas	34	5	39
Denton	48	5	53
Ellis	28	5	33
Fannin	12	5	17
Freestone	6	5	11
Grayson	21	5	26
Henderson	15	4	19
Jack	3	5	8
Kaufman	24	5	29
Navarro	13	5	18
Parker	16	5	21
Rockwall	17	3	20
Tarrant	44	5	49
Wise	13	5	18
Adjustment for Multi-County WUGs	-60		-60
TOTAL	**285**	**75**	**360**

1.6 Pre-Existing Plans for Water Supply Development

1.6.1 Previous Water Supply Planning in Region C

Appendix A is a list of water-related plans and reports for Region C. The region has a long history of successful local water supply planning and development. Significant plans for developing additional water supplies in Region C in the near future include the following:

- Dallas Water Utilities plans to connect its currently unused supplies in Lake Palestine to its system by participating with Tarrant Regional Water District in the Integrated Pipeline Project.
- Tarrant Regional Water District plans to expand the facilities that divert return flows of treated wastewater from the Trinity River into Cedar Creek and Richland-Chambers Reservoirs. TRWD also plans to complete the Integrated Pipeline Project in cooperation with Dallas Water Utilities to deliver additional water from East Texas.
- North Texas Municipal Water District plans to construct the Main Stem Pump Station and the Lower Bois d'Arc Creek Reservoir.

- Several Region C water suppliers have received permits to reuse return flows of treated wastewater in Region C and are developing projects to use those supplies.
- The Upper Trinity Regional Water District has received a water right permit for the proposed Lake Ralph Hall on the North Sulphur River in Fannin County.
- Region C water suppliers are considering the development of water supplies in the Sulphur Basin to the east. Alternatives include Lake Wright Patman, the proposed George Parkhouse Reservoirs (North and South), the proposed Marvin Nichols Reservoir, and the proposed Marvin Nichols Reservoir (South). The U.S. Army Corps of Engineers has ongoing studies to determine the optimal options for water supply in the Sulphur River Basin.
- Region C water suppliers are exploring obtaining water from existing sources in Oklahoma and from Toledo Bend Reservoir in East Texas.
- Other Region C suppliers are planning and developing smaller water supply projects to meet local needs.

As discussed in Section 1.4.3, there has been increasing reuse of treated wastewater in Region C in recent years. There are several permits for significant indirect reuse projects in the region. In addition to these permitted indirect reuse projects, many of the reservoirs in Region C make indirect reuse of treated wastewater return flows in their watersheds, which increase reservoir yields. Direct reuse, often for irrigation of golf courses, is also increasing in the region. It is clear that reuse of treated wastewater will remain a significant part of future water planning for Region C.

1.6.2 Recommendations in the 2011 Region C Water Plan and the 2012 State Water Plan

The most significant recommendations for Region C in the *2011 Region C Water Plan* [8] and the 2012 State Water Plan [9] are summarized below. (A more detailed discussion of the recommendations is available in the original documents.)

A large part of the water supplied in Region C is provided by five major water providers: Dallas Water Utilities, Tarrant Regional Water District, North Texas Municipal Water District, Fort Worth, and the Trinity River Authority. In the *2011 Region C Water Plan* and the 2012 State Water Plan, these five entities are expected to provide the majority of the water supply for Region C through 2060. Recommended water management strategies in the *2011 Region C Water Plan* and the 2012 State Water Plan to meet the needs of these major water providers include the following:

Dallas Water Utilities

- Conservation
- Main Stem Trinity River Pump Station (Lake Ray Hubbard Reuse)

- Additional pipeline from Lake Tawakoni
- Connect Lake Palestine to its system
- Develop supplies from Lake Wright Patman
- Develop Lake Fastrill replacement
- Develop direct and indirect reuse projects
- Develop additional water treatment capacity as needed
- Other alternatives for Dallas Water Utilities include obtaining supplies from Lake Texoma, Toledo Bend Reservoir, Lake O' the Pines, Lake Livingston, the development of Lake Columbia, Marvin Nichols Reservoir, the George Parkhouse Reservoirs, Oklahoma water, or groundwater.

Tarrant Regional Water District

- Conservation
- Develop the proposed reuse project to pump water from the Trinity River into Cedar Creek Reservoir and Richland-Chambers Reservoir to supplement yields (Phase I complete)
- Develop a water supply from existing water sources in Oklahoma
- Develop a third pipeline (Integrated Pipeline Project) from Cedar Creek Reservoir and Richland-Chambers Reservoir to Tarrant County
- Participate in the Marvin Nichols Reservoir project
- Participate in the Toledo Bend Reservoir Phase I project
- Other alternatives for Tarrant Regional Water District include the development of Lake Tehuacana, obtaining water from Lake Texoma, obtaining water from Wright Patman and obtaining water from Lake Livingston.

North Texas Municipal Water District

- Conservation
- Develop Main Stem pump station
- Develop additional water supplies from Lake Texoma (done)
- Develop a water supply from existing water sources in Oklahoma and Toledo Bend Reservoir in Texas
- Develop Lower Bois d'Arc Creek Reservoir on Bois d'Arc Creek in Fannin Co.
- Participate in the Marvin Nichols Reservoir project
- Develop additional water treatment capacity and treated water transmission system improvements as needed
- Other alternatives for North Texas Municipal Water District include obtaining water from Dallas, Wright Patman, or Lake O' the Pines.

City of Fort Worth

- Conservation

- Continue to obtain raw water from Tarrant Regional Water District
- Develop direct reuse projects (Village Creek reuse completed)
- Renew contracts with its existing customers as they expire
- Develop additional water treatment and transmission capacity as needed

Trinity River Authority

- Conservation
- Expand Tarrant County Water Supply Project facilities as needed
- Further develop the Ellis County water supply project
- Develop reuse projects:
    - Additional golf course and landscape irrigation in the Las Colinas area
    - Golf course and landscape irrigation in Denton and Tarrant Counties
    - Steam electric power supply in Dallas, Ellis, Freestone, and Kaufman Counties
    - Reuse for municipal supply through Joe Pool Lake and Grapevine Lake
    - Reuse for irrigation in Denton and Tarrant Counties and municipal use in Tarrant County.

In addition to the strategies recommended for the five major water providers above, the 2011 Region C plan included strategies for individual water user groups. Major types of strategies included the following:

- Conservation for all Water User Groups
- Continued development and expansion of existing regional water supply systems
- Connection of water user groups to larger regional systems
- Construction of additional water treatment capacity as needed
- Development of reuse projects to meet growing steam electric and other demands

The estimated capital costs for all recommended water management strategies in the *2011 Region C Water Plan* total $21.5 billion in 2008 dollars.

1.6.3 Conservation Planning in Region C

Significant new information regarding water conservation in Region C has been developed since completion of the previous Region C Water Plans. Sources of new information include individual water conservation plans, the Water Conservation Advisory Council, and conservation implementation by Region C entities. Below is a summary of this information. A more detailed discussion is presented in Section 5E of this report.

Water Conservation Plans. The TCEQ requires water conservation plans for all municipal, industrial, and mining water users with surface water rights of 1,000 acre-feet per year or more, all irrigation water users with surface water rights of 10,000 acre-feet per year or more, and all retail public utilities with 3,300 connections or more. Water conservation plans are also required for all water users applying for a state water right and may also be required for entities seeking state funding for water supply projects. Primarily as a result of these requirements, many entities in Region C and around the state have developed water conservation and drought contingency plans. These plans have significantly improved the awareness of water conservation in Region C and stimulated additional conservation efforts. Beginning May 1, 2009, these plans are to be updated and resubmitted to TCEQ every five years.

Information has been collected from the various water conservation plans of Region C entities and used to help determine future savings from water conservation. A detailed discussion of this is presented in Section 5E of this report.

Water Conservation Task Force and Water Conservation Advisory Council. The 80th Regular Session of the Texas Legislature (2007), via the passage of Senate Bill 3 and House Bill 4, directed the TWDB to appoint members to the Water Conservation Advisory Council. The Water Conservation Advisory Council replaced the Water Conservation Implementation Task Force, which was created in 2003 and abolished on January 1, 2005.

In 2004, the Task Force published the *Water Conservation Best Management Practices Guide* (10). An update to this report, *Understanding Best Management Practices*, was published in February 2013 (11). Also published in 2004 was the *Report to the 79th Legislature* (12), which included a number of recommendations regarding water conservation and regional water planning. These recommendations include the following:

- The Best Management Practices (BMPs) should be voluntary and state policies should recognize the fundamental decision-making primacy and prerogative of planning groups, municipalities, industrial and agricultural water users, and water providers.
- Municipal water user groups that are developing water conservation plans should consider a target that implements a minimum one percent per year reduction in total per capita water use, based on a rolling five-year average, until the total per capita water use is 140 gallons per capita per day (gpcd) or less. [Note that the Task Force also recommended that water supplied by indirect reuse should not be included when computing per capita use.]
- The TWDB should work with manufacturers of water-using equipment, water utilities, water users, and others to reduce overall statewide indoor water use to 50 gpcd through education, research, and funding programs.

- Municipal water user groups with projected water needs should first meet or reduce the need using advanced water conservation strategies (beyond implementation of state plumbing fixture requirements and adoption and implementation of water conservation education programs).

In December 2012, the Advisory Council published a *Report on Progress of Water Conservation in Texas* (13). The report included a number of recommendations regarding water conservation and regional water planning. These recommendations include the following:

- Water providers and users should implement the conservation strategies in the state and regional water plans and in their water conservation plans.
- Monitor the implementation of water conservation strategies as recommended in the regional water plans.
- Improve and streamline the reporting methods for collection and analysis of water use and water conservation savings.
- Develop guidance for utilities and water user groups in collection of these data.
- Retail water providers would benefit from conducting annual water loss audits.
- The capabilities of a statewide water conservation public awareness campaign, Water IQ: Know your water, should be expanded.
- Use economic incentives to encourage the early adoption of voluntary agricultural water conservation best management practices to secure adequate water supplies for future generations of Texans.
- The Board and the Commission should improve efforts and guidance to actively promote the Water Conservation Best Management Practices Guide as a fundamental resource for the development of water conservation plans.
- Increase efforts to integrate energy and water supply planning as well as improve incentives for less water intensive systems.
- Higher education institutions of Texas should encourage research and academic growth in the areas of water conservation.
- Additional emphasis is needed on industrial, commercial, and institutional water conservation programs.
- Improvements should be made to provide more technical assistance to water providers and water user groups for water management activities during times of drought.

Conservation Implementation by Region C Entities. In addition to the water conservation plans discussed above, Region C entities have implemented water conservation strategies since the completion of the *2011 Region C Water Plan* (8).

In particular, Dallas Water Utilities, North Texas Municipal Water District, and Tarrant Regional Water District have continued the implementation of large scale conservation programs. More detail on these programs is presented in Section 5E of this report.

Finally, as mentioned in previous sections, several Region C entities have continued to develop and implement direct and indirect reuse projects.

1.7 Preliminary Assessment of Current Preparations for Drought in Region C

The drought of record for most water supplies used in Region C occurred from 1950 through 1957. The drought of 2011 through early 2015 caused low inflows and low water levels for many Region C lakes. The recent dry summers in 1996, 1998, 1999, 2000, 2006, and 2011 placed considerable stress on water suppliers throughout Texas, including Region C. Many Region C water suppliers have already made or are currently making improvements to increase delivery of raw and treated water under drought conditions. Some smaller suppliers in Region C faced a shortage of supplies in the recent droughts. Most of those entities have moved to address this problem by connecting to a larger supplier or by developing additional supplies on their own.

Most of the water conservation plans developed in response to TCEQ and TWDB requirements include a drought contingency plan. In addition to its regional planning provisions, Senate Bill One included a requirement that all public water suppliers and irrigation districts develop and implement a drought contingency plan. Refer to Chapter 7 for additional information on current preparations for drought in Region C.

1.8 Other Water-Related Programs

In addition to the Senate Bill One regional planning efforts, there are a number of other significant water-related programs that will affect water supply efforts in Region C. Perhaps the most important are Texas Commission on Environmental Quality water rights permitting, the Clean Rivers Program, the Clean Water Act, and the Safe Drinking Water Act.

Texas Commission on Environmental Quality (TCEQ) Water Rights Permitting. Surface water in Texas is a public resource, and the TCEQ is empowered to grant water rights that allow beneficial use of that resource. The development of any new surface water supply requires a water right permit. In recent years, TCEQ has increased its scrutiny of the environmental impacts of water supply projects, and permitting has become more difficult and complex. Among its many other provisions, Senate Bill One set out formal criteria for the permitting of interbasin transfers for water supply. Since many of the major sources of supply that have been considered for Region C involve interbasin transfers, these criteria will be important in Region C planning.

Clean Rivers Program. The Clean Rivers Program is a Texas program overseen by TCEQ and funded by fees assessed on water use and wastewater discharge permit holders. The program is designed to provide information on water quality issues and to develop plans to resolve water quality problems. The Clean Rivers Program is carried out by local entities. In Region C, the program is carried out by river authorities: the Trinity River Authority in the Trinity Basin, the Red River Authority in the Red Basin, the Brazos River Authority in the Brazos Basin, the Sulphur River Basin Authority in the Sulphur Basin, and the Sabine River Authority in the Sabine Basin.

Clean Water Act. The Clean Water Act is a federal law designed to protect water quality. The parts of the act which have the greatest impact on water supplies are the National Pollutant Discharge Elimination System (NPDES) permitting process, which covers wastewater treatment plant and storm water discharges, and the Section 404 permitting program for the discharge of dredged and fill material into the waters of the United States, which affects construction for development of water resources. In Texas, the state has recently taken over the NPDES permitting system, renaming it the Texas Pollutant Discharge Elimination System (TPDES). The TPDES Program sets the discharge requirements for wastewater treatment plants and for storm water discharges associated with construction and industrial activities. The Section 404 permit program is handled by the U.S. Army Corps of Engineers. Section 404 permitting is a required step in the development of a new reservoir and is also required for pipelines, pump stations, and other facilities constructed in or through waters of the United States.

Safe Drinking Water Act (SDWA). The Safe Drinking Water Act is a federal program that regulates drinking water supplies. In recent years, new requirements introduced under the SDWA have required significant changes to water treatment. On-going SDWA initiatives will continue to impact water treatment requirements. Some of the initiatives that may have significant impacts in Region C are the reduction in allowable levels of trihalomethanes in treated water, the requirement for reduction of total organic carbon levels in raw water, and the reduction of the allowable level of arsenic in drinking water.

SDWA Groundwater Rules. The EPA has developed groundwater monitoring regulations as part of the SWDA. TCEQ is the agency responsible for implementing these rules in Texas and has developed a source sampling compliance program for groundwater systems which took effect on December 1, 2009. Requirements of this rule are meant to ensure that 1) groundwater systems conduct source water monitoring, 2) address significant deficiencies, 3) address source water fecal contamination, and 4) implement corrective actions. The Groundwater Rule has the potential to encourage entities on groundwater to consider alternative sources. Systems that utilize groundwater as a supplemental supply may find that the additional regulatory monitoring and reporting are more trouble than the supplemental supply is worth.

1.9 Water Loss Audits

Texas Water Development Board water loss audit information for entities in Region C was compiled for 2010 through 2013 and is included in Appendix B. The primary purposes of a water loss audit are to account for all of the water being used and to identify potential areas where water can be saved. Water audits track multiple sources of water loss that are commonly described as apparent loss and real loss. Apparent loss is water that was used but for which the utility did not receive compensation. Apparent losses are associated with customer meters under-registering, billing adjustment and waivers, and unauthorized consumption. Real loss is water that was physically lost from the system before it could be used, including main breaks and leaks, customer service line breaks and leaks, and storage overflows. The sum of the apparent loss and the real loss make up the total water loss for a utility [(14)]. The water loss audits were considered in the development of water conservation recommendations.

1.10 Agricultural and Natural Resources in Region C

1.10.1 Springs in Region C

No springs in Region C are currently used as a significant source of water supply. Springs were important sources of water supply to Native Americans and in the initial settlement of the area and had great influence on the initial patterns of settlement. Groundwater development and the resulting water level declines have caused many springs to disappear and greatly diminished the flow from those that remain [(15)].

The TPWD has identified a number of small to medium-sized springs in Region C [(16)]. Table 1.11 shows the distribution and number of these springs as of 1980. Former springs are springs that have run dry due to groundwater pumping, sedimentation caused by surface erosion, or other causes [(17)].

Table 1.11
Distribution and Estimated Size of Springs and Seeps

County	Medium (2.8 – 28 cfs)	Small (0.28 – 2.8 cfs)	Very Small (0.028 – 0.28 cfs)	Seep (Less than 0.028 cfs)	Former
Collin	0	3	10	1	4
Cooke	0	3	9	3	1
Dallas	2	6	2	0	4
Denton	0	3	8	1	1
Ellis	0	0	0	0	1
Fannin	0	3	6	3	1
Grayson	0	2	12	1	1
Parker	0	8	3	2	6
Rockwall	0	0	1	0	2
Tarrant	3	6	1	3	5
Wise	0	7	4	3	2

Note: Data are from Texas Parks and Wildlife Department (16).

1.10.2 Wetlands

According to the regulatory definition of the U.S. Army Corps of Engineers (18), wetlands are "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Areas classified as wetlands are often dependent on water from streams and reservoirs. Some of the important functions of wetlands include providing food and habitat for fish and wildlife, water quality improvement, flood protection, shoreline erosion control, and groundwater exchange, in addition to opportunities for human recreation, education, and research.

The Natural Resources Conservation Service (NRCS) has mapped and quantified areas of hydric soils for all but five of the counties in Region C. The agency makes these data available through its local county offices and, in some cases, publishes the acreages of soil series in the soil survey report for the county. Hydric soil is defined as "soil that in its undrained condition is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation" (19). Thus, the area of hydric soils mapped in a county provides an indication of the potential extent of wetlands in that county. However, as implied in the definition, some areas mapped as hydric soils may not occur as wetlands because the hydrology has been changed to preclude saturation or inundation.

Table 1.12 is a list of acreages of hydric soils for the counties in Region C for which the data are available. The hydric soil areas range from just over one percent of the county area in Collin, Cooke, and Tarrant counties to approximately 24 percent in Henderson County. The acreages of hydric soils listed in Table 1.12 should be considered as an indicator of the relative abundance of wetlands in the counties and not as an absolute quantity.

Table 1.12
Hydric Soils Mapped by the Natural Resources Conservation Service for the Counties in Region C

County	Total County Acreage (Acres)	Hydric Soil Acreage within County (Acres)	Percent of County (%)
Collin	565,760	8,620	1.52
Cooke	568,320	7,100	1.25
Dallas	577,920	53,570	9.27
Denton	611,200	10,460	1.71
Ellis	608,000	Not Available	
Fannin	574,080	Not Available	
Freestone	574,720	85,855	14.94
Grayson	627,840	29,240	4.66
Henderson [a]	604,800	142,540	23.57
Jack	588,800	Not Available	
Kaufman	517,760	Not Available	
Navarro	695,680	86,100	12.38
Parker	581,760	35,350	6.08
Rockwall	94,080	Not Available	
Tarrant	574,080	9,410	1.64
Wise	592,000	13,100	2.21

Note: a. The values for Henderson County include all of Henderson County, not just the Region C portion.

1.10.3 Endangered or Threatened Species

The Endangered Species Act (ESA) provides for the conservation of endangered or threatened species and their critical habitats. Recovery plans are created for each species to provide protocols, timelines, and costs for recovering endangered species. Federal agencies are required to ensure that their activities do not jeopardize listed species or their critical habitats. In addition, many federal agencies incorporate conservation of listed species into their existing authorities.

The U.S. Fish and Wildlife Service (USFWS) [20] is the authority responsible for the federal listing of endangered and threatened species. The Texas Parks and Wildlife Department (TPWD) maintains a separate listing of species of special concern in the Texas Biological and Conservation Data System [21].

Table 1.13 lists federal endangered or threatened species identified by USFWS in Region C counties. Table 1.14 lists species of special concern as identified at the state level and species that have limited range within the state. County designations indicate that a species is either known to occur or existing habitat is suitable to support a species in the particular county.

Table 1.13
Federal Endangered or Threatened Species in Region C [a]

Species	Federal Status [b]	County															
		Collin	Cooke	Dallas	Denton	Ellis	Fannin	Freestone	Grayson	Henderson	Jack	Kaufman	Navarro	Parker	Rockwall	Tarrant	Wise
Bald Eagle	DM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Louisiana Black Bear	T						X										
Black Capped Vireo	E		X	X							X			X			X
Golden Cheeked Warbler	E			X							X						
Least Tern	E		X	X	X		X	X	X			X				X	
Large Fruited Sand Verbena	E							X									
Navasota Ladies' Tresses	E							X									
Piping Plover	T	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Smalleye Shiner[c]	E													X			
Sharpnose Shiner[c]	E													X			
Whooping Crane	E	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X

Notes: a. Information obtained from U.S. Fish and Wildlife Service [20].
b. DM is a federally delisted taxon, recovered, being monitored first five years; E is federally listed as endangered; T is federally listed as threatened.
c. Two species were added in response to Texas Parks and Wildlife comment on 2016 Initially Prepared Plan.

1.10.4 Stream Segments with Significant Natural Resources

In Region C, the TPWD has identified river and stream segments classified as having significant natural resources in their report *Ecologically Significant River and Stream Segments of Region C, Regional Water Planning Area* [22]. Stream segments have been placed on this list because they have been identified by TPWD as having one or more of the following: biological function, hydrologic function, riparian conservation area, high water quality/aesthetic value, or endangered species/unique communities. Out of 324 total streams identified within Region C, TPWD chose the ten as ecologically significant.

Table 1.14
State Species of Special Concern in Region C [a]

Species	State Status [a]	Collin [c]	Cooke [c]	Dallas [c]	Denton [c]	Ellis [c]	Fannin [c]	Freestone [c]	Grayson [c]	Henderson [c]	Jack [d]	Kaufman [c]	Navarro [c]	Parker [c]	Rockwall [c]	Tarrant [c]	Wise [c]
A Crayfish	R	X															
Alligator Snapping Turtle	T	X		X		X	X	X	X	X		X	X		X		
American Burying Beetle	R						X										
American Peregrine Falcon	T	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Arctic Peregrine Falcon	T	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bachman's Sparrow	T							X		X							
Baird's Sparrow	R										X						
Bald Eagle	T	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black Bear	T						X			X							
Black Lordithon Rove Beetle	R			X													
Black Capped Vireo	E		X	X							X						
Blackside Darter	T						X										X
Bleached Skimmer	R										X						
Blue Sucker	T						X		X								
Brazos Water Snake	T													X			
Carrizon Leather Flower										X							
Cave Myotis Bat	R			X													
Cerulean Warbler	R		X				X		X								
Chapman's Yellow-Eyed Grass	R							X		X							
Comanche Peak Prairie-Clover	R													X			X
Creek Chubsucker	T						X		X								
Creeper (squawfoot)	R							X		X		X	X				
Eskimo Curlew	E		X				X		X								
Glen Rose Yucca	R			X	X									X		X	
Golden-Cheeked Warbler	E			X		X								X			
Goldeye	R						X		X								
Gray Wolf	E		X								X			X		X	X
Hall's Baby Bulrush	R																X
Henslow's Sparrow	R	X	X	X	X	X	X	X	X	X		X	X		X	X	
Houston toad	E							X									
Interior Least Tern	E	X	X	X		X	X	X	X	X		X	X	X		X	X
Large-fruited sand-verbena	E							X									
Louisiana Pigtoe[d]	T	X		X	X	X		X		X		X	X		X	X	

Species	State Status [a]	Collin [c]	Cooke [c]	Dallas [c]	Denton [c]	Ellis [c]	Fannin [c]	Freestone [c]	Grayson [c]	Henderson [c]	Jack [d]	Kaufman [c]	Navarro [c]	Parker [c]	Rockwall [c]	Tarrant [c]	Wise [c]
Mountain Plover	R										X			X			X
Navasota Ladies Tresses	E							X									
Northern Scarlet Snake	T									X							
Orangebelly Darter	R						X		X								
Paddlefish	T						X		X								
Panicled Indigobush										X							
Peregrine Falcon	T	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Piping Plover	T	X		X			X	X	X	X		X	X		X		
Plains Spotted Skunk	R	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red Wolf	E	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Rough Stem Aster	R							X		X							
Sabine Map Turtle	R									X							
Sandbank Pocketbook[d]	T							X		X		X	X		X		
Sharpnose Shiner	R													X			
Shovelnose Sturgeon	T						X		X							X	X
Smalleye Shiner	R													X			
Smallheaded Pipewort	R									X							
Southeastern Myotis Bat	R							X		X							
Southern Hickorynut[d]	T									X							
Sprague's Pipit		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Taillight Shiner	R						X										
Texas Fawnsfoot[d]	T													X			
Texas Garter Snake	R	X		X	X	X		X				X	X	X	X	X	X
Texas Heelsplitter[d]	T	X	X	X	X	X		X	X	X	X	X	X		X	X	X
Texas Horned Lizard	T	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Texas Kangaroo Rat	T										X						
Texas Pigtoe[d]	T			X		X		X		X		X	X				
Timber/Canebrake Rattlesnake	T	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Warnock's Coral-Root	R			X													
Western Burrowing Owl	RX	X	X	X	X	X			X		X	X	X	X	X	X	X
Western Sand Darter	R						X										
White Faced Ibis	T	X		X	X	X						X	X		X		
Whooping Crane	E	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Wood Stork	T	X	X	X	X	X	X	X	X	X		X	X		X		

Notes: a. Information is obtained from TPWD [21].

b. E is endangered, T is threatened, R is rare.

c. Last updated 4/28/2014.

d. In response to Texas Parks and Wildlife Department comment on 2016 Initially Prepared Plan, these species were changed from Rare to Threatened.

e. In response to Texas Parks and Wildlife Department comment on 2016 Initially Prepared Plan, the following species were removed from this table: Fawnsfoot, Wabash Pigtoe, Common Pimpleback, Little Spectaclecase, Wartyback, and White Heelsplitter.

More information on streams and the consideration of Unique Stream Segments is presented in Chapter 8. The ten stream segments identified by TPWD as ecologically significant are:

- Bois d'Arc Creek (from the confluence with the Red River in Fannin County upstream to its headwaters in Eastern Grayson County)
- Brazos River (from a point 330 feet upstream of FM 2580 in Parker County upstream to the Parker/Palo Pinto County line)
- Buffalo/Linn Creek (from the confluence with Alligator Creek upstream to State Route 164 (Buffalo Creek) and from the confluence with Buffalo Creek upstream to County Road 691 (Linn Creek))
- Clear Creek (from the confluence with the Elm Fork of the Trinity River northeast of Denton in Denton County upstream to the Denton/Cooke County line)
- Coffee Mill Creek (from the confluence with Bois d'Arc Creek in Fannin County upstream to its headwaters)
- Elm Fork (from a point 110 yards upstream of U.S. 380 in Denton County upstream to Ray Roberts Dam in Denton County)
- Elm Fork (from the confluence with the West Fork of the Trinity River in Dallas County upstream to California Crossing Road in Dallas County)
- Lost Creek (from the confluence with the West Fork of the Trinity River upstream to its headwaters in Jack County)
- Purtis Creek (from the Henderson County line upstream to its headwaters)
- Trinity River (from Interstate Highway 45 in Dallas County upstream to MacArthur Boulevard in Dallas County)

1.10.5 Navigation

There is very little commercial navigation in Region C. However, the Corps of Engineers has defined two stretches of river in Region C that qualify as "navigable". In the Red River Basin, the segment of the Red River from Denison Dam forming Lake Texoma upstream to Warrens Bend in Cooke County is defined as navigable. In the Trinity River Basin, the Trinity River has a reach that is considered to be "navigable" from the southeastern border of Freestone County up to Riverside Drive in Fort Worth. While these rivers meet the legal definition of navigable waters, they are not currently used for this purpose.

1.10.6 Agriculture and Prime Farmland

Table 1.15 gives some basic data on agricultural production in Region C, based on the 2012 Agricultural Census from the U.S. Department of Agriculture (USDA) [(23)]. Region C includes over 6,177,000 acres in farms and over 1,739,000 acres of cropland. Irrigated agriculture does not play a significant role in

Table 1.15
2012 U.S. Department of Agriculture County Data

	Collin	Cooke	Dallas	Denton	Ellis	Fannin	Freestone	Grayson
Farms	2,264	1,946	839	3,203	2,264	2,515	1,517	2,562
Land in Farms (acres)	312,806	503,827	83,754	383,533	473,860	513,651	421,303	431,268
Crop Land (acres)	136,635	132,431	35,936	131,894	224,446	200,014	47,139	176,390
Harvested Crop Land (acres)	122,961	101,684	25,942	103,340	189,280	160,319	35,238	152,115
Irrigated Crop Land (acres)	6,186	359	1,416	3,315	411	1,172	424	3,513
Market Value ($1,000)								
Crops	50,811	18,507	38,198	35,317	67,356	39,811	5,769	66,859
Livestock	27,001	44,812	6,292	101,679	24,034	31,330	38,313	25,089
Total	77,812	63,319	44,490	136,996	91,390	71,141	44,082	91,948

	Henderson[b]	Jack	Kaufman	Navarro	Parker	Rockwall	Tarrant	Wise	Total
Farms	1,961	864	3,041	2,573	4,370	440	1,278	3,095	34,732
Land in Farms (acres)	345,628	527,895	449,181	558,096	494,492	45,399	145,661	487,078	6,177,432
Crop Land (acres)	81,924	35,814	130,532	146,074	93,854	14,124	38,033	114,295	1,739,535
Harvested Crop Land (acres)	60,344	13,972	100,248	107,620	62,221	11,623	24,028	75,739	1,346,674
Irrigated Crop Land (acres)	1,399	400	1,360	904	2,211	63	881	2,775	26,789
Market Value ($1,000)									
Crops	17,357	2,279	20,295	31,422	15,429	2,007	25,191	16,410	453,018
Livestock	32,165	20,222	38,686	34,955	58,859	2,107	9,411	33,457	528,412
Total	49,522	22,501	58,981	66,377	74,288	4,114	34,602	49,867	981,430

Notes: a. Data are from the U.S. Department of Agriculture [(23)].
b. Data for Henderson County are for the entire county.

Region C, with less than 2 percent of the harvested cropland being irrigated. The market value of agricultural products is significant in all Region C counties, with a total value for 2012 of over $981,430,000. (Separate data are not available for the portion of Henderson County in Region C, so the USDA data include the entire county.)

The Natural Resources Conservation Service (NRCS) defines prime farmland as "land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses (24)." As part of the National Resources Inventory, the NRCS has identified prime farmland throughout the country. Figure 1.4 shows the distribution of prime farmland in Region C. Each color in Figure 1.4 represents the percentage of the total acreage that is prime farmland of any kind. (There are four categories of prime farmland in the NRCS STATSGO database for Texas: prime farmland, prime farmland if drained, prime farmland if protected from flooding or not frequently flooded during the growing season, and prime farmland if irrigated.) There are large areas of prime farmland in Cooke, Denton, Collin, Tarrant, Dallas, and Ellis Counties. There are localized areas of irrigated agriculture in Region C. Table 1.4 shows that 46 percent of the year 2011 water use for irrigation in Region C came from groundwater (compared to only 10 percent of total water use from groundwater.) Texas Water Development Board Report 269 (25) studied groundwater in most of Region C (except for Jack and Henderson Counties and part of Navarro County). Most irrigation wells in the study area were scattered over the outcrop areas of the Trinity and the Woodbine aquifers with only a few areas of concentrated activity. The largest concentration of irrigation wells is located on the Woodbine outcrop in an area bounded by western Grayson County, the eastern edge of Cooke County, and the northeastern corner of Denton County. Approximately 80 irrigation wells operated in this region (as of 1982), and several produced as much as 900 gpm. Several smaller irrigation well developments were located in Parker County and Wise County in the Trinity aquifer. There were also irrigation wells in Fannin County producing from the alluvium along the Red River (25).

1.10.7 State and Federal Natural Resource Holdings

The TPWD operates several state parks in Region C: Bonham State Park in Fannin County, Cedar Hill State Park in Dallas County, Eisenhower State Park in Grayson County, Fairfield Lake State Park in Freestone County, Fort Richardson State Park & Historic Site in Jack County, Lake Mineral Wells State Park in Parker County, Lake Ray Roberts State Park in Denton and Cooke Counties, and Purtis Creek State Park partially located in Henderson County. TPWD also operates Caddo Wildlife Management Area in Fannin County, Cedar Creek Islands Wildlife Management Area in Henderson County, Ray Roberts Wildlife Management Area in Cooke, Denton, and Grayson Counties, and Richland Creek Wildlife Management Area in Freestone and Navarro Counties.

Federal government natural resource holdings in Region C include the following:

- Parks and other land around all of the Corps of Engineers lakes in the region (Texoma, Ray Roberts, Lewisville, Lavon, Grapevine, Benbrook, Joe Pool, Bardwell, and Navarro Mills)
- Hagerman National Wildlife Refuge on the shore of Lake Texoma in Grayson County
- Caddo National Grasslands in Fannin County
- Lyndon B. Johnson National Grasslands in Wise County.

Area reservoirs provide a variety of recreational benefits, as well as water supply. Table 1.16 lists the reservoirs located in Region C that have national or state lands associated with them and the recreational opportunities available at these sites [(26) - (28)]. Recreational activities typically found at these sites include camping, fishing, boating, hiking, swimming, and picnicking.

1.10.8 Oil and Gas Resources

Oil and natural gas fields are significant natural resources in portions of Region C. Gas production in the Barnett Shale has rapidly increased in the past decade due in large part to improvements in hydraulic fracture stimulation technologies [(29)]. This process uses water at high pressure to fracture the shale formation and greatly improves the gas production from a well. This additional use of water in gas production has significantly increased the mining use in Region C.

As of September 2011, five counties within Region C had 1,300 or more regular producing gas wells (Denton, Freestone, Parker, Tarrant and Wise), with Wise County having the most at 4,275 [(30)]. As of September 2011, two counties within Region C had 1,500 or more regular producing oil wells (Cooke and Jack) and three Counties had between 500 and 1,000 regular producing oil wells (Grayson, Navarro, and Wise) [(30)] .

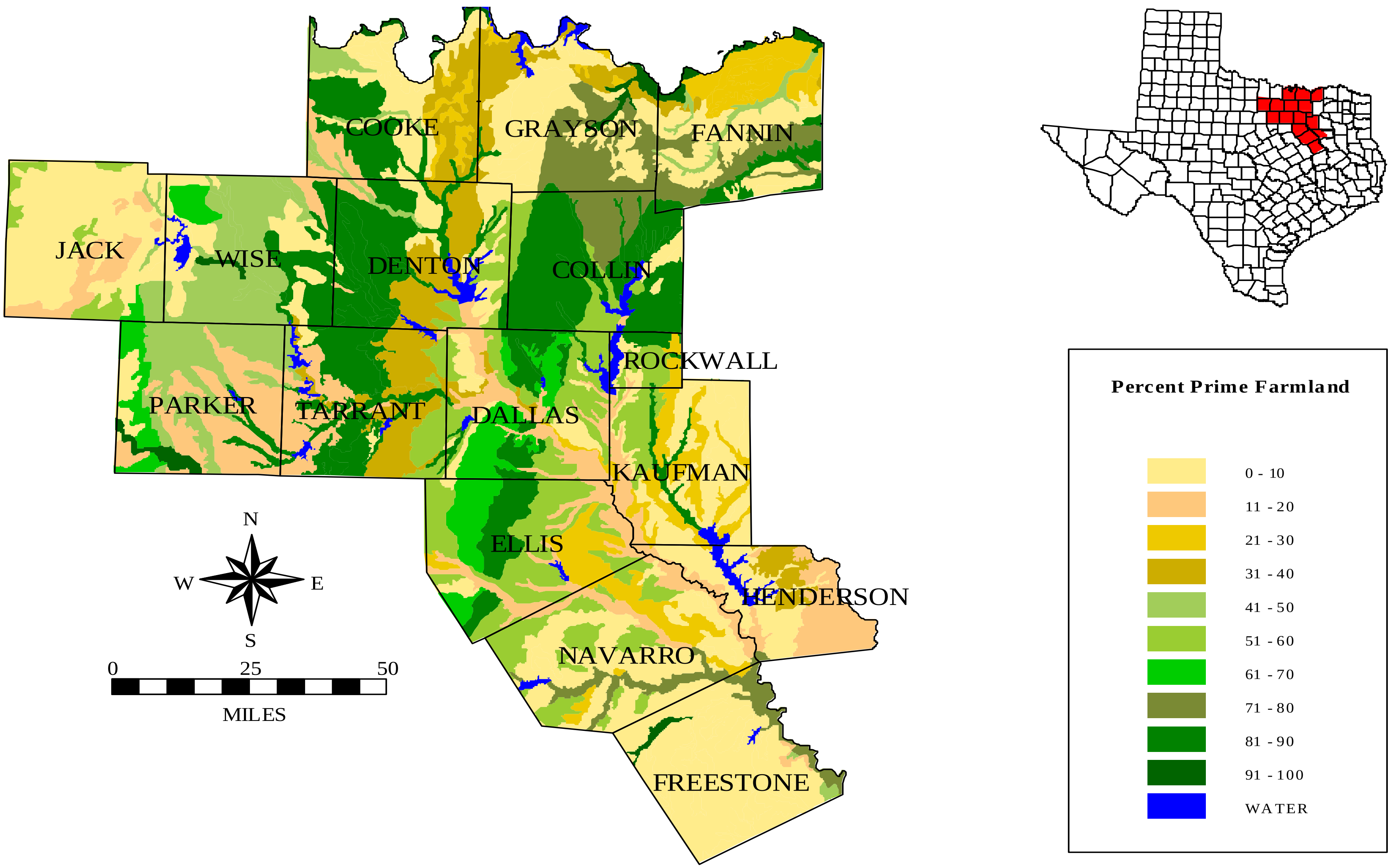
Table 1.16
Recreational Activities at Region C Reservoirs

Reservoir	National Lands	State Lands	Camping	Fishing	Boating	Hiking/Nature Trails	Hunting	Swimming	Picnic Sites	Bicycling Trails	Equestrian Trails	Playgrounds
Lavon	X		X	X	X	X	X	X	X	X	X	
Texoma	X	X	X	X	X	X	X	X	X	X	X	X
Bonham		X	X	X	X	X		X	X	X		X
Ray Roberts	X	X	X	X	X	X	X	X	X	X	X	X
Lewisville	X		X	X	X	X	X	X	X	X	X	
Benbrook	X		X	X	X	X	X	X	X	X	X	
Grapevine	X		X	X	X	X	X	X	X	X	X	
Joe Pool	X	X	X	X	X	X		X	X	X	X	X
Bardwell	X		X	X	X	X	X	X	X	X	X	
Navarro Mills	X		X	X	X	X	X	X	X			
Fairfield		X	X	X	X	X		X	X	X	X	X
Mineral Wells		X	X	X	X	X		X	X	X	X	X
Lost Creek Reservoir		X	X	X	X	X		X	X	X	X	
Cedar Ck. Reservoir		X	X	X	X	X		X	X	X		

1.10.9 Lignite Coal Fields

There are some lignite coal resources in Region C [31]. Paleozoic rocks with bituminous coal deposits underlie most of Jack County and small portions of Wise and Parker Counties. Near surface (to 200 feet in depth) lignite deposits in the Wilcox Group underlie significant portions of Freestone, Navarro, and Henderson Counties. Deposits of deep basin lignite (200 - 2,000 feet in depth) in rocks of the Wilcox Group underlie a significant portion of Freestone County. The most significant current lignite production in Region C is from the near surface Wilcox Group deposits in Freestone County to supply Luminant's Big Brown Steam Electric Station on Lake Fairfield [32].

Figure 1.4
Percent Prime Farmland in Region C



1.11 Summary of Threats and Constraints to Water Supply in Region C

The most significant potential threats to existing water supplies in Region C are surface water quality concerns, groundwater drawdown, groundwater quality, and invasive species. Constraints on the development of new supplies include the availability of sites and unappropriated water for new water supply reservoirs and the challenges imposed by environmental concerns and permitting.

1.11.1 Need to Develop Additional Supplies

Most of the water suppliers in Region C will have to develop additional supplies before 2070. The major water suppliers have supplies in excess of current needs, but they will require additional supplies to meet projected growth. Some smaller water suppliers face a more urgent need for water. Their needs can be addressed by local water supply projects or by purchasing water from a major water supplier.

1.11.2 Surface Water Quality Concerns

The Texas Commission on Environmental Quality (TCEQ) publishes the *Texas Integrated Report of Surface Water Quality* every two years in accordance with the schedule mandated under section 303(d) and 305(b) of the Clean Water Act. The latest EPA-approved edition of the Water Quality Inventory was approved by the EPA in May 2013 [33]. The TCEQ has also established a list of stream segments for which it intends to develop total maximum daily load (TMDL) evaluations to address water quality concerns. None of the proposed TMDL studies in Region C are due to concerns related to public water supply. Most are due to general use, aquatic life, contact recreation, and fish consumption.

Many of the water supply reservoirs in Region C are experiencing increasing discharges of treated wastewater in their watersheds. To date, this has not presented a problem for public water supplies, but increased amounts of wastewater and greater nutrient loads may lead to concerns about eutrophication in some lakes. The largest wastewater treatment plants are on the Trinity River in the Dallas-Fort Worth Metroplex and do not discharge into the watershed of any Region C reservoir. However, there are existing and proposed projects to withdraw water from rivers downstream of municipal wastewater treatment plants, polish the water with wetlands treatment, and convey the water to Region C water supply reservoirs. Additionally, there are significant permitted discharges upstream from many reservoirs in the region, and return flows are tending to increase with time.

In December 1998, the U.S. EPA published the *Stage 1 Disinfectants and Disinfection Byproducts (D/DBP) Rule* [34], which applies to water systems that treat surface water with a chemical disinfectant. This rule sets forth Maximum Contaminant Levels (MCLs) for a number of different contaminants including: total organic carbon, trihalomethane, haloacetic acid, and dissolved solids. Under certain circumstances, the rule mandates the use of enhanced coagulation to remove total organic carbon (TOC), an indicator of potential disinfection byproduct formation. Effective January 1, 2004, all community and nontransient, noncommunity systems were required to comply with the MCLs for TTHM (0.080 milligrams per liter, or mg/l) and HAA5 (0.060 mg/l) based on the running annual average for the entire distribution system.

In January 2006, the U.S. EPA published the *Stage 2 Disinfectants and Disinfection Byproducts (D/DBP) Rule*, which requires utilities to evaluate their distribution systems to identify locations with high DBP concentrations. The utilities will then use these locations as sampling sites for DBP compliance monitoring [35]. This rule requires compliance with the MCLs for TTHM and HAA5 at each monitoring location as soon as six years after promulgation.

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) [36] is a companion rule to Stage 2 DBPR. This rule requires additional Cryptosporidium treatment techniques for higher-risk systems as well as provisions to reduce risks from uncovered finished water reservoirs and provisions to ensure that microbial protection is maintained when DBP concentrations are decreased.

Dissolved solids in the Red River and Lake Texoma along the northern boundary of Region C are generally high in comparison to other current Region C supplies. The use of Lake Texoma water for public supply requires desalination (Sherman, Red River Authority Preston Shores) or blending with higher quality water (North Texas MWD, Denison). This requirement has limited the use of water from the Red River and Lake Texoma for public water supply. The Red River Authority is serving as a local sponsor for the Red River Chloride Control Project, which may serve to improve the quality of Lake Texoma water for public water supply by diverting saline water before it reaches the lake. Before any of the chloride control efforts were initiated, about 3,450 tons per day of chlorides entered the Red River. Although portions of the project have been online since 1987, construction efforts were temporarily placed on hold while a cost-sharing partner for the operation and maintenance responsibilities was identified. The Water Resources Development Act of 2007 reaffirmed that operation and maintenance responsibilities would be federally funded. In 2008, funding for efforts in Texas was used to complete contract plans and specifications and continue environmental monitoring activities.

The Texas Commission on Environmental Quality (TCEQ) has the primary responsibility for enforcing state laws regarding water pollution. Chapter 7 of the Texas Water Code also establishes laws to allow local governments to combat environmental crime, including water pollution. Local enforcement of these laws can supplement the enforcement activities of TCEQ and help protect Texas' water resources.

1.11.3 Invasive Species

The appearance of several invasive and/or harmful species (including zebra mussels, giant salvinia, and golden algae) poses a potential threat to water supplies throughout the state of Texas. Continued monitoring and management by water suppliers in Region C will be necessary in the coming decades. Invasive species will likely be an ongoing area of interest to Region C, as the appearance of additional invasive species in the future remains a possibility.

Zebra mussel (*Dreissena polymorpha*) is an invasive species that is native to Eurasia and is believed to have first entered the United States in 1988 through the ballast water in ships entering the Great Lakes. Zebra mussels multiply rapidly, can be easily transported on boats, and can clog intakes, pumps, pipes and other water supply infrastructure. Additionally, zebra mussels can impact fish populations, native mussels, and birds.

As of July 27, 2015 TPWD has confirmed the existence of zebra mussels in Lake Texoma, Lake Ray Roberts, Lewisville Lake, Lake Bridgeport, Lake Lavon, Lake Waco, and Lake Belton. These reservoirs, with the exception of Lake Waco and Lake Belton, are all used as water supply sources in Region C. In addition, the mussels have been found on isolated occasions in Lake Ray Hubbard, Lake Grapevine, Lake Fork Reservoir, Lake Tawakoni, the Red River below Lake Texoma, the Elm Fork of the Trinity River below Lake Ray Roberts, and Sister Grove Creek, a tributary to Lake Lavon. Due to the number of water transfers in Region C and other potential pathways of transferring zebra mussels into a reservoir (boats, birds), reservoirs should continue to be monitored for the appearance of zebra mussels. As zebra mussels spread into Region C water supply reservoirs, the operation and maintenance cost of control and removal from water supply infrastructure could be significant. To avoid further spread of this invasive species, strategies in this plan that involve transfer of water from basins or reservoirs with known presence of zebra mussels have been modified to transfer water directly to water treatment plants.

Giant salvinia (*salvinia molesta*) is a floating plant that is native to South America. Colonies of giant salvinia can develop, covering the water surface. Under certain environmental conditions (light, temperature, and available nutrients), oxygen depletion and fish kills can occur. In addition, colonies of giant salvinia can block sunlight penetration to submerged plants. Lower water levels typically experienced during the summer months, help prevent the spread of giant salvinia.

Giant salvinia was first discovered in Texas in the Houston area in 1998, and has spread to over a dozen Texas lakes, including Toledo Bend and Sam Rayburn. Due to the number of water transfers in Region C and other potential pathways of transferring, reservoirs should continue to be monitored for the appearance of giant salvinia. If giant salvinia appears in Region C water supply reservoirs, mechanical techniques and herbicide can be applied during the summer months to control the population.

Golden alga (*prymnesium parvum*) is a type of aquatic plant that produces toxins that can be lethal to fish, mussels, clams, and certain amphibians. Under certain environmental conditions, an explosive increase in the algal population can occur, which can result in fish kills. Golden alga typically occurs in waters with a high TDS concentration, and appears to have a competitive advantage over beneficial algae during the winter and spring months. Golden alga blooms have occurred in the Rio Grande, Brazos, Canadian, Colorado, and Red River basins. Golden alga was first identified in Texas in the 1980s; it remains unclear whether the species is native or invasive. Research is ongoing to better understand, detect, and manage golden alga blooms.

1.11.4 Groundwater Drawdown

Overdevelopment of aquifers and the resulting decline in water levels poses a threat to small water suppliers and to household water use in rural areas. As water levels decline, the cost of pumping water grows and water quality generally suffers. Wells that go dry must be redrilled to reach deeper portions of the aquifer. Water level declines have been reported in localized areas in each of the major and minor aquifers in Region C. In particular, the annual pumpage from the Trinity aquifer in some counties is estimated to be greater than the annual recharge [25]. Concern about groundwater drawdown is likely to prevent any substantial increase in groundwater use in Region C and may require conversion to surface water in some areas.

1.11.5 Groundwater Quality

Figure 1.1 shows the major and minor aquifers in Region C. Major aquifers are the Trinity aquifer and the Carrizo-Wilcox aquifer. Minor aquifers are the Woodbine aquifer, the Nacatoch aquifer, and the Queen

City aquifer. Water quality in the Trinity aquifer is acceptable for most municipal and industrial purposes [25, 37]. However, in some areas, natural concentrations of arsenic, fluoride, nitrate, chloride, iron, manganese, sulfate, and total dissolved solids in excess of either primary or secondary drinking water standards can be found. Water on the outcrop tends to be harder with relatively high iron concentration. Downdip, water tends to be softer, with concentrations of TDS, chlorides, and sulfates higher than on the outcrop. Groundwater contamination from man-made sources is found in localized areas. Texas Water Development Board Report 269 reported contaminated water in wells located between Springtown in Parker County and Decatur in Wise County [25]. The apparent source of the contamination was improperly completed oil and gas wells. Other potential contaminant sources (agricultural practices, abandoned wells, septic systems, etc.) are known to exist on the Trinity outcrop, but existing data are insufficient to quantify their impact on the aquifer [37].

Water from the Carrizo-Wilcox aquifer is fresh to slightly saline. In the outcrop, the water is hard and low in TDS [38]. In the downdip, the water is softer, with a higher temperature and higher TDS concentrations [38]. Hydrogen sulfide and methane may be found in localized areas [38]. In much of the northeastern part of the aquifer, water is excessively corrosive and has high iron content [38]. In this area, the groundwater may also have high concentrations of TDS, sulfate, and chloride. Some of these sites may be mineralized due to waters passing through lignite deposits, especially in the case of high sulfate [38]. Another cause may be the historic practice of storing oil field brines in unlined surface storage pits [38]. In Freestone County, excessive iron concentration may be a problem; a well completed in recent years by the City of Fairfield contained water with a high iron concentration [39]. Excessive iron concentrations can be removed by treatment.

Water quality in the layers of the Woodbine aquifer used for public water supply is good along the outcrop. Water quality decreases downdip (southeast), with increasing concentrations of sodium, chloride, TDS, and bicarbonate. High sulfate and boron concentrations may be found in Tarrant, Dallas, Ellis, and Navarro Counties. Excessive iron concentrations also occur in parts of the Woodbine formation.

The Nacatoch and Queen City aquifers provide very little water in Region C. Available data indicate that the quality of the Nacatoch in this area is acceptable for most uses. Water quality data on the Queen City aquifer in Region C are very limited.

As stated at the end of Section 1.8, the new SDWA Groundwater Rule will affect water user groups currently on groundwater. This rule has the potential to encourage entities on groundwater to consider alternative sources. Systems that utilize groundwater as a supplemental supply may find that the additional regulatory monitoring and reporting does not warrant the supplemental coverage.

1.12 Water-Related Threats to Agricultural and Natural Resources in Region C

Water-related threats to agricultural and natural resources in Region C include changes to natural flow conditions, water quality concerns, and inundation of land due to reservoir development. In general, there are few significant water-related threats to agricultural resources in Region C due to the limited use of water for agricultural purposes. Water-related threats to natural resources are more significant. Further information on how this plan is consistent with the long-term protection of the State's agricultural and natural resources is presented in Section 6.4 of this report.

1.12.1 Changes to Natural Flow Conditions

Reservoir development, groundwater drawdown, and return flows of treated wastewater have greatly altered natural flow patterns in Region C. Spring flows in Region C have diminished, and many springs have dried up because of groundwater development and the resulting drawdown. This has reduced reliable flows for many tributary streams. Reservoir development also changes natural hydrology, diminishing flood flows and capturing low flows. (Some reservoirs provide steady flows in downstream reaches due to releases to empty flood control storage or meet permit requirements.) Downstream from the Dallas-Fort Worth Metroplex, base flows on the Trinity River have been greatly increased due to return flows of treated wastewater. It is unlikely that future changes to flow conditions in Region C will be as dramatic as those that have already occurred. If additional reservoirs are developed, they will likely be required to release some inflow to maintain downstream stream conditions, which was often not required in the past. It is likely that return flows from the Dallas-Fort Worth area will continue to increase over the long term, thus increasing flows in the Trinity River. On balance, this will probably enhance habitat in this reach.

1.12.2 Water Quality Concerns

There are a number of reaches in which the TCEQ has documented concerns over water quality impacts to aquatic life or fish consumption. In general, these concerns are due to low dissolved oxygen levels or to levels of lead, pesticides, or other pollutants that can harm aquatic life or present a threat to humans eating fish in which these compounds tend to accumulate. Baseline water quality conditions used to evaluate water management strategies are included in Appendix M.

1.12.3 Inundation Due to Reservoir Development

At various times, a number of new reservoirs have been considered for development in Region C, including:

- Tehuacana Reservoir on Tehuacana Creek in Freestone County.
- Tennessee Colony Reservoir on the main stem of the Trinity River in Freestone, Navarro, Henderson, and Anderson Counties.
- Roanoke Reservoir on Denton Creek in Denton County.
- Italy Reservoir on Chambers Creek in Ellis and Navarro Counties.
- Emhouse Reservoir at the confluence of Chambers and Waxahachie Creeks in Ellis and Navarro Counties.
- Upper Red Oak Reservoir and Lower Red Oak Reservoir on Red Oak Creek in Ellis County.
- Bear Creek Reservoir on Bear Creek in Ellis County.
- Lower Bois d'Arc Reservoir on Bois d'Arc Creek in Fannin County.
- Ralph Hall Reservoir on North Fork Sulphur River in Fannin County.

At this time, Lower Bois d'Arc Reservoir, Lake Ralph Hall, and Tehuacana Reservoir seem to be the most likely to be developed of these projects. The impacts of a new reservoir on natural resources include the inundation of habitat, often including wetlands and bottomland hardwoods, and changes to downstream flow patterns. Depending on the location, a reservoir may also inundate prime farmland. The impacts of specific projects depend on the location, the mitigation required, and the operation of the projects.

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2 Population and Water Demand Projections

2.1 Historical Perspective

This section presents the population and water demand projections for Region C as approved by the Texas Water Development Board (TWDB). The section includes a discussion on historical growth trends in Region C, the basis of projections, and the final population and water demand projections for Region C.

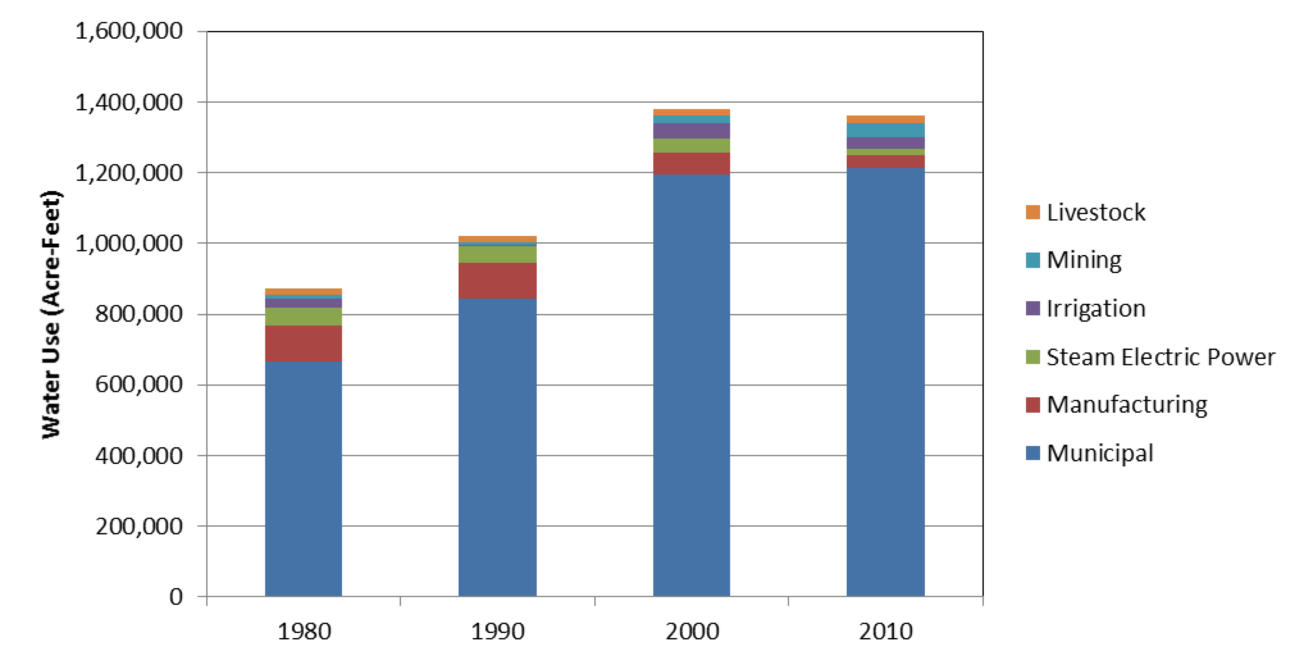
The sixteen counties that comprise Region C have been among the fastest growing areas in Texas and the nation since the 1950s. The region's highest population density is centered in and near Dallas and Tarrant Counties. For many years, the population growth in the region was concentrated in the cities of Dallas and Fort Worth. In the 1960s and 1970s, growth spilled over into near suburbs in Dallas and Tarrant Counties. Then in the 1980s and more so in the 1990s and 2000s, the growth spilled into Collin, Denton, Rockwall and Ellis Counties.

According to the U.S. Census Bureau, the year 2010 population of Region C was 6,477,835 (1). The State Demographer estimated that the July 1, 2012 population of Region C was 6,716,014 (2). The total Region C water demand was 1,359,917 acre-feet in the year 2010 (4). Figure 2.1 shows the historical water use for Region C from 1980 to 2010.

2.2 Population Projections

Population and water demand projections have been developed for all cities with population over 500 and for any retail water supplier (such as a water supply corporation or a utility district) which provides an annual average of over 0.25 million gallons per day of water supply. This group of entities is collectively referred to as water user groups (WUGs). Any rural population not included in a specific water user group has been included in the "County Other" water user group for each county. Nineteen new water user groups have been added for this update of the Region C Plan because their populations have recently reached at least 500 or because they have reached the 0.25 MGD supply threshold. Ten water user groups have been removed because they no longer meet the population or water supply threshold. There are over 280 municipal water user groups in Region C.

Figure 2.1
Historical Water Use in Region C



2.2.1 Basis for Population Projections

Population projections presented in this section are based on draft the population projections provided by the Texas Water Development Board on March 5, 2013. Those draft projections were based on population projections developed by the Texas State Demographer using 2010 Census data. Region C analyzed the draft projections and made changes based on input from water user groups, wholesale water providers (WWPs) in Region C, the North Central Texas Council of Governments, and other sources. TWDB allowed population adjustments to be made between WUGs and Counties, but required that the total regional population remain the same as the total of their draft projections.

As stated above, revisions to the projections were made based on input from water user groups and wholesale water providers in Region C. Each WUG in Region C was surveyed regarding their population projections. (A copy of this survey is included in Appendix D.) In the survey, each WUG was provided a copy of their population projections from the *2011 Region C Water Plan* [3] and TWDB's draft population projections for the 2016 Region C Water Plan. Each WUG was asked if they were in agreement with the projections. If the WUG was not in agreement with the projections they were asked to provide alternative projections. Many WUGs responded with suggestions for revisions to the population projections. A summary of these survey responses is included in Appendix E. Additionally, interviews were set up with certain WUGs and WWPs to gather more detailed information. Phone and email correspondence was also used to gather additional information. The data obtained from all the surveys, interviews, and correspondence was compiled and used to develop a final set of recommended population projections. Email notification was sent to all WUGs for which revisions were proposed. A summary of the justification for all changes made to population projections is included in Appendix E.

As required by TWDB regulations, these projections were posted for public review on the Region C website in advance of the Region C Planning Group meeting at which they were considered for approval. The population projections were approved by the Region C Water Planning Group at the August 5, 2013 Public Meeting, and were subsequently adopted by TWDB.

It should be noted the population and demand projections for this plan were approved in August 2013. The Collin County population projections were developed using the most current information available at the time, and for Collin County the 2013 Collin County Mobility Plan study was used. In October 2015, Collin County updated the population projections for their Mobility Plan using significantly different development assumptions. This resulted in a much higher total buildout population for the county, increasing by over 50 percent. As a result, the population and municipal demand projections used in this 2016 Region C Water Plan for Collin County may be increased significantly in future regional plans. This updated information will be included in future Region C plans with appropriate strategies to meet these higher demands.

2.2.2 Water User Group Projections

Table 2.1 presents the projected population for the Region C counties, as adopted by TWDB. The projected 2020 population for Region C is 7,504,200. The 2020 projection is about 6 percent less than the projected 2020 population projection from the 2011 Region C Water Plan of 7,971,728. The projected 2060 population for Region C is 12,742,283. The 2060 projection compares very closely to the projected 2060 population projection from the 2011 Region C Water Plan of 13,045,592 (being about 2% less). Generally, the overall long-term population projections are consistent with previous plan. In addition, the projections presented in this plan reflect lower population growth in Dallas, Tarrant, and Collin Counties than in the 2011 Region C Water Plan with more growth occurring in the surrounding counties.

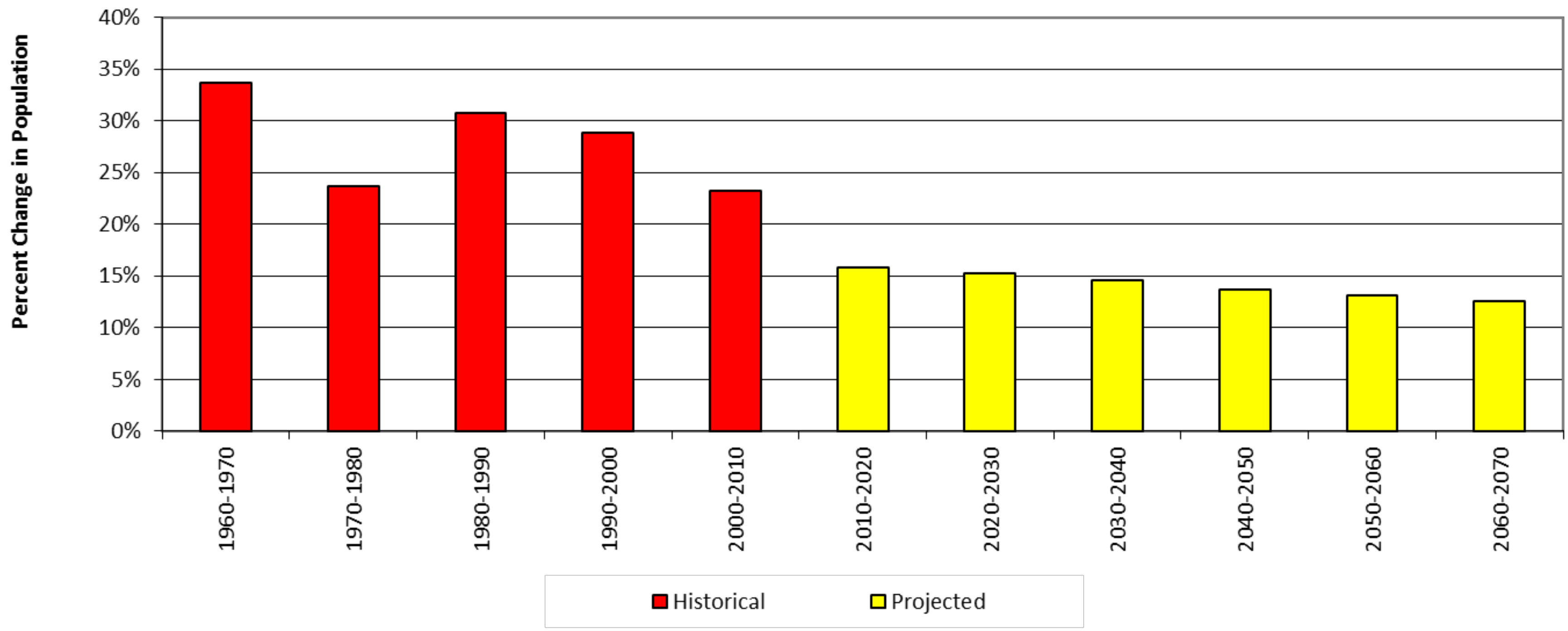
Figure 2.2 shows the historical and projected rate of growth for Region C. This figure shows that the population projections for Region C represent a substantial slowing in the historical rate of growth. Appendix F includes the projected populations for Region C, by water user group, by county, and by basin

Table 2.1
Adopted Population Projections for Region C by County

County	Historical 1990	Historical 2000	Historical 2010	2020	2030	2040	2050	2060	2070
Collin	264,036	491,774	782,341	956,716	1,116,830	1,363,229	1,646,663	1,853,878	2,053,638
Cooke	30,777	36,363	38,437	42,033	45,121	48,079	53,532	64,047	96,463
Dallas	1,852,810	2,218,774	2,368,139	2,566,134	2,822,809	3,107,541	3,355,539	3,552,602	3,697,105
Denton	273,525	432,976	662,614	901,645	1,135,397	1,348,271	1,576,424	1,846,314	2,090,485
Ellis	85,167	111,360	149,610	183,814	224,000	276,931	362,668	488,768	683,974
Fannin	24,804	31,242	33,915	38,346	43,391	52,743	69,221	101,915	138,497
Freestone	15,818	17,867	19,816	20,437	21,077	22,947	31,142	44,475	73,287
Grayson	95,021	110,595	120,877	134,785	148,056	164,524	185,564	250,872	344,127
Henderson*	41,309	51,984	78,532	60,175	64,059	69,737	76,204	101,827	136,269
Jack	6,981	8,763	9,044	9,751	10,409	10,817	11,033	11,190	11,291
Kaufman	52,220	71,313	103,350	146,623	191,707	239,940	309,619	428,577	571,840
Navarro	39,926	45,124	47,735	52,544	57,032	61,667	71,452	86,952	107,814
Parker	64,785	88,495	116,927	199,955	255,133	291,007	366,596	480,530	629,277
Rockwall	25,604	43,080	78,337	104,887	137,304	160,918	198,279	249,594	301,970
Tarrant	1,170,103	1,446,219	1,809,034	2,006,473	2,281,666	2,579,553	2,797,060	2,991,972	3,184,348
Wise	34,679	48,793	59,127	79,882	94,734	110,668	149,261	188,770	227,527
Region C Total	**4,077,565**	**5,254,722**	**6,477,835**	**7,504,200**	**8,648,725**	**9,908,572**	**11,260,257**	**12,742,283**	**14,347,912**

*Projections for Henderson County only include the portion of Henderson County located within Region C.

Figure 2.2
Historical and Projected Population Growth Rates by Decade in Region C



as approved by the RCWPG and TWDB. The tables in Appendix F are generated directly from TWDB's Regional Water Planning Database (DB17). Many of the water user groups have population that is split among multiple basin, counties, and regions. For convenience, Appendix F also includes the total projected populations for those water user groups in multiple basins, counties, and regions.

Water Demand Projections

2.2.3 Basis for Municipal Water Demand Projections

The municipal water demand projections presented in this section are based on per capita dry-year water use and the adopted population projections from the previous section. On March 5, 2013 TWDB provided draft per-capita projections for each WUG based on each WUG's 2011 actual per capita use as calculated by TWDB. These 2020 through 2070 projections included estimated water reductions due to savings from plumbing code requirements for low-flow fixtures. TWDB chose the year 2011 as the base year because it represented the most severe drought year in recent history for the majority of the state of Texas, although 2011 was not the most severe recent drought year for much of Region C.

The consultants for Region C met with TWDB staff and pointed out that for many Region C water user groups, 2006 and 2008 were more representative of dry-year, high-demand conditions than 2011. (In parts of Region C, unlike most of Texas, there were periodic light rains in the summer of 2011 that suppressed the demand for water.) The Region C consultants suggested that the dry-year per capita demands should be based on the highest per capita use in recent years and then reduced over time to reflect savings from low flow water fixtures. TWDB staff did not agree. As a result, the projected dry-year demands for some Water User Groups in Region C underestimate true dry-year needs. It is hoped that this will be corrected in future rounds of planning.

TWDB did allow Region C to make changes to this 2011 base-year per capita water use in very limited instances and required substantial justification and documentations in order to allow these changes. Overall, 73% of TWDB's recommended base-year per capita values were retained. For the remaining WUGs, adjustments and corrections were made based on specific information obtained by Region C. A detailed memorandum was developed to outline the changes in select gpcd's and to document the justification to those changes. This memorandum is included in Appendix E. Even with the limited variance from the 2011 per capita water use, consultants for Region C still feel the demands for some Water User Groups adopted for this plan underestimate true dry-year needs.

Using the final base-year per capita values for each WUG, the TWDB calculated the 2020 through 2070 per capita values incorporating the reduction in per capita values each decade that are attributed to water savings associated with state and federally regulated plumbing codes (low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards). TWDB then calculated the volume of water savings (rounded to the hundredth acre-foot) for each WUG that can be attributed to these plumbing codes. This information (split by county and WUG) is included at the end of Appendix E. In total, Region C's water savings due to plumbing codes are 73,851 acre-feet in 2020, increasing to 246,869 acre-feet in 2070.

As with the population projections, a survey was sent to each WUG containing their demand projections from the *2011 Region C Water Plan* [(1)] and TWDB's draft demand projections for the 2016 Region C Plan. Each WUG was asked if they were in agreement with the projections. If the WUG was not in agreement with the projections they were asked to provide alternative projections. A summary of these survey responses is included in Appendix E. The survey responses were used to identify instances where TWDB base-year 2011 per capita data may have contained an error. (TWDB data is based on self-reported data submitted by the WUGs each year.) If a potential problem was identified, additional data was gathered and if necessary submitted to TWDB as justification for base per capita adjustment. Email notification was sent to all WUGs for which revisions were made.

As required by TWDB regulations, these projections were posted for public review on the Region C website in advance of the Region C Planning Group meeting at which they were considered for approval. The municipal demand projections were approved by the Region C Water Planning Group at the August 5, 2013 Public Meeting.

After the adoption of the municipal demand projections, it was discovered that the demand for DFW International Airport has been inadvertently left out of the original municipal demand projections. Even though DFWIA is generally considered a non-municipal demand, for the purposes of regional planning it is included in the County Other municipal category. Adjustments were made to the Tarrant County Other and Dallas County Other municipal demands to include the demand of DFWIA. These adjustments were approved by the RCWPG at the March 31, 2014 Public Meeting. A summary of the revisions to this demand is included in Appendix E. All Region C recommended municipal demand projections were subsequently approved by TWDB.

2.2.4 Basis for Non-Municipal Water Demand Projections

Non-municipal water demand projections are reported on a county-wide basis and include manufacturing, steam electric power, irrigation, mining, and livestock use. Projections of the non-municipal water demands were based on the draft projections provided by TWDB on October 12, 2011. TWDB draft irrigation and livestock demands were based on an average of TWDB's 2005-2009 irrigation and livestock water use estimates, respectively. TWDB draft manufacturing demands were based on year 2004-2008 data from TWDB's Water Use Survey (WUS). TWDB draft mining demands were based on a study by the University of Texas' Bureau of Economic Geology [(6)]. TWDB draft steam electric power generation demands were based on projections from the *2011 Region C Water Plan* and the 2008 TWDB report *Water Demand Projections for Power Generation in Texas* [(7)].

Region C was given the opportunity to request adjustments to the non-municipal projections if needed. Region C did request a number of revisions, and those revisions are detailed in separate memoranda for each use category. Appendix E contains the memoranda detailing the revisions to non-municipal demands for Region C. As required by TWDB regulations, the proposed projections were posted for public review on the Region C website in advance of the Region C Planning Group meeting at which they were considered for approval. The projections were approved by the Region C Water Planning Group at the April 30, 2012 Public Meeting.

TWDB subsequently adopted most of the revisions proposed by the RCWPG with the exception of the mining demands in Collin, Grayson and Rockwall Counties. The Region C Water Planning Group then adopted the original TWDB draft mining projections for those three counties at the August 25, 2013 Public Meeting.

2.2.5 Water User Group Projections

Table 2.2 presents the projected total dry-year water demand for the Region C counties, as adopted by TWDB. Table 2.3 and Figure 2.33 show the projected dry-year water demand for the region by type of use. Table 2.4 through Table 2.19 show the projected dry-year water demand for each Region C County by type of use. The water demand projections are listed by water user group, by county, and by basin in Appendix G. The tables in Appendix G are generated directly from TWDB's Regional Water Planning Database (DB17). Again, for convenience, Appendix G also lists the total projected municipal water demand for those water user groups that are split among multiple basins, counties, and regions.

Figure 2.3
Adopted Projections for Dry-Year Water Use by Category in Region C

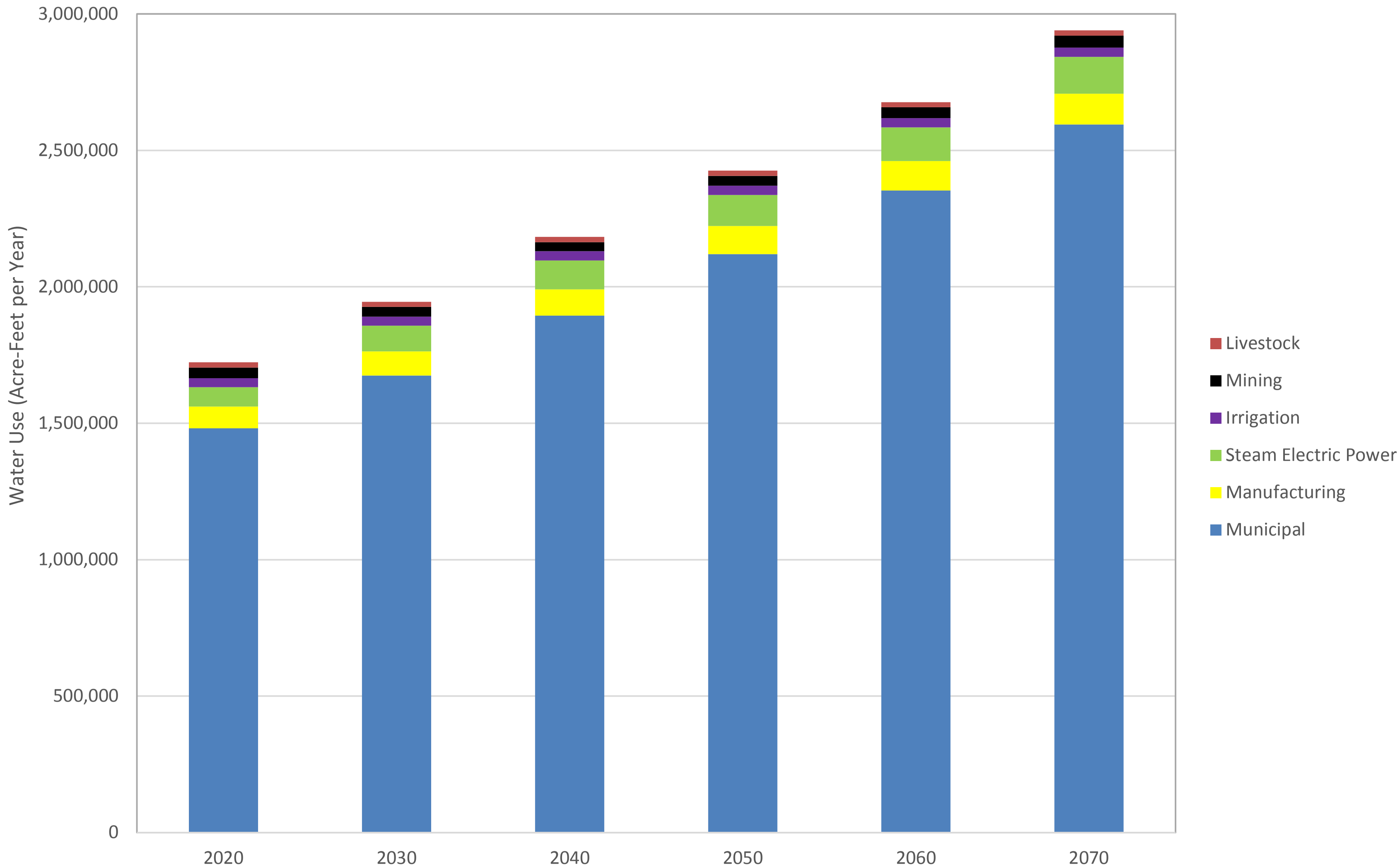


Table 2.2
Adopted Total Dry-Year Water Demand Projections for Region C by County

County	Projected Water Dry Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Collin	224,022	256,375	305,795	354,437	384,105	412,735
Cooke	9,725	9,276	9,005	9,683	11,137	15,366
Dallas	577,785	618,807	674,672	720,897	757,834	782,053
Denton	185,710	226,706	265,820	306,284	353,071	392,342
Ellis	40,255	47,596	58,626	73,656	94,634	127,173
Fannin	21,517	27,201	28,967	31,697	36,106	41,013
Freestone	35,073	34,856	35,121	39,948	46,635	55,960
Grayson	40,623	49,497	52,616	56,853	68,207	85,117
Henderson	13,462	16,928	18,519	20,422	25,705	32,402
Jack	6,498	6,942	7,127	7,382	7,648	7,979
Kaufman	29,204	34,977	40,737	49,301	62,910	78,996
Navarro	20,683	27,025	28,015	29,746	32,110	35,114
Parker	36,785	46,580	51,788	62,476	77,868	98,251
Rockwall	20,419	27,595	31,483	36,966	44,600	53,074
Tarrant	431,918	481,457	536,594	580,170	620,092	659,399
Wise	29,646	33,173	38,063	45,919	54,174	62,906
Region C Total	**1,723,325**	**1,944,991**	**2,182,948**	**2,425,837**	**2,676,836**	**2,939,880**

Table 2.3
Adopted Dry-Year Water Demand Projections for Region C by Type of Use

Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	1,481,530	1,675,385	1,894,722	2,119,813	2,352,818	2,594,833
Manufacturing	79,540	87,958	96,154	103,307	107,899	112,839
Steam Electric Power	71,452	94,176	106,033	113,641	124,001	135,443
Irrigation	33,167	33,383	33,599	33,815	34,032	34,248
Mining	38,858	35,311	33,662	36,483	39,308	43,739
Livestock	18,778	18,778	18,778	18,778	18,778	18,778
Region C Total	**1,723,325**	**1,944,991**	**2,182,948**	**2,425,837**	**2,676,836**	**2,939,880**

Table 2.4
Adopted Dry-Year Water Demand Projections for Collin County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	215,996	248,030	296,881	345,282	374,359	402,609
Manufacturing	3,456	3,888	4,319	4,706	5,109	5,547
Steam Electric Power	715	602	740	594	782	724
Irrigation	2,995	2,995	2,995	2,995	2,995	2,995
Mining	0	0	0	0	0	0
Livestock	860	860	860	860	860	860
Total	**224,022**	**256,375**	**305,795**	**354,437**	**384,105**	**412,735**

Table 2.5
Adopted Dry-Year Water Demand Projections for Cooke County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	6,122	6,335	6,565	7,157	8,522	12,650
Manufacturing	226	247	268	286	310	336
Steam Electric Power	0	0	0	0	0	0
Irrigation	300	300	300	300	300	300
Mining	1,583	900	378	446	511	586
Livestock	1,494	1,494	1,494	1,494	1,494	1,494
Total	**9,725**	**9,276**	**9,005**	**9,683**	**11,137**	**15,366**

Table 2.6
Adopted Dry-Year Water Demand Projections for Dallas County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	521,968	560,015	607,125	651,210	687,875	711,818
Manufacturing	37,791	41,148	44,214	46,703	46,983	47,265
Steam Electric Power	5,000	5,000	11,066	11,066	11,066	11,066
Irrigation	9,134	9,134	9,134	9,134	9,134	9,134
Mining	3,038	2,656	2,279	1,930	1,922	1,916
Livestock	854	854	854	854	854	854
Total	**577,785**	**618,807**	**674,672**	**720,897**	**757,834**	**782,053**

Table 2.7
Adopted Dry-Year Water Demand Projections for Denton County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	176,110	218,419	256,631	295,870	341,498	379,398
Manufacturing	1,446	1,643	1,843	2,020	2,194	2,383
Steam Electric Power	646	733	819	906	993	1,088
Irrigation	2,137	2,137	2,137	2,137	2,137	2,137
Mining	4,326	2,729	3,345	4,306	5,204	6,291
Livestock	1,045	1,045	1,045	1,045	1,045	1,045
Total	**185,710**	**226,706**	**265,820**	**306,284**	**353,071**	**392,342**

Table 2.8
Adopted Dry-Year Water Demand Projections for Ellis County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	32,686	39,053	47,684	60,586	79,481	109,139
Manufacturing	5,247	5,403	5,560	5,716	5,716	5,716
Steam Electric Power	698	1,450	3,741	5,754	7,878	10,786
Irrigation	572	572	572	572	572	572
Mining	147	213	164	123	82	55
Livestock	905	905	905	905	905	905
Total	**40,255**	**47,596**	**58,626**	**73,656**	**94,634**	**127,173**

Table 2.9
Adopted Dry-Year Water Demand Projections for Fannin County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	4,969	5,533	6,854	9,043	12,793	17,006
Manufacturing	88	97	106	114	124	135
Steam Electric Power	6,363	11,474	11,910	12,443	13,092	13,775
Irrigation	8,301	8,301	8,301	8,301	8,301	8,301
Mining	128	128	128	128	128	128
Livestock	1,668	1,668	1,668	1,668	1,668	1,668
Total	**21,517**	**27,201**	**28,967**	**31,697**	**36,106**	**41,013**

Table 2.10
Adopted Dry-Year Water Demand Projections for Freestone County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	2,476	2,480	2,599	3,670	5,030	7,911
Manufacturing	100	111	121	130	136	142
Steam Electric Power	25,000	25,000	25,000	28,712	33,963	40,175
Irrigation	298	298	298	298	298	298
Mining	5,347	5,115	5,251	5,286	5,356	5,582
Livestock	1,852	1,852	1,852	1,852	1,852	1,852
Total	**35,073**	**34,856**	**35,121**	**39,948**	**46,635**	**55,960**

Table 2.11
Adopted Dry-Year Water Demand Projections for Grayson County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	25,580	27,254	29,741	33,410	44,009	60,119
Manufacturing	4,905	5,329	5,729	6,065	6,584	7,147
Steam Electric Power	6,163	12,711	12,711	12,711	12,711	12,711
Irrigation	2,438	2,654	2,870	3,086	3,303	3,519
Mining	79	91	107	123	142	163
Livestock	1,458	1,458	1,458	1,458	1,458	1,458
Total	**40,623**	**49,497**	**52,616**	**56,853**	**68,207**	**85,117**

Table 2.12
Adopted Dry-Year Water Demand Projections for Henderson County (Region C Portion only) by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	7,790	8,237	8,809	9,692	13,956	19,634
Manufacturing	575	594	613	633	652	671
Steam Electric Power	4,000	7,000	8,000	9,000	10,000	11,000
Irrigation	0	0	0	0	0	0
Mining	607	607	607	607	607	607
Livestock	490	490	490	490	490	490
Total	**13,462**	**16,928**	**18,519**	**20,422**	**25,705**	**32,402**

Table 2.13
Adopted Dry-Year Water Demand Projections for Jack County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	1,243	1,283	1,302	1,311	1,327	1,337
Manufacturing	2	2	2	2	2	2
Steam Electric Power	2,665	2,879	3,092	3,305	3,518	3,745
Irrigation	101	101	101	101	101	101
Mining	1,555	1,745	1,698	1,731	1,768	1,862
Livestock	932	932	932	932	932	932
Total	**6,498**	**6,942**	**7,127**	**7,382**	**7,648**	**7,979**

Table 2.14
Adopted Dry-Year Water Demand Projections for Kaufman County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	18,199	23,826	29,422	37,766	51,170	67,015
Manufacturing	813	869	928	993	1,061	1,134
Steam Electric Power	8,000	8,000	8,000	8,000	8,000	8,000
Irrigation	179	179	179	179	179	179
Mining	296	386	491	646	783	951
Livestock	1,717	1,717	1,717	1,717	1,717	1,717
Total	**29,204**	**34,977**	**40,737**	**49,301**	**62,910**	**78,996**

Table 2.15
Adopted Dry-Year Water Demand Projections for Navarro County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	9,084	9,663	10,307	11,613	13,608	16,207
Manufacturing	1,114	1,249	1,384	1,519	1,654	1,789
Steam Electric Power	8,000	13,440	13,440	13,440	13,440	13,440
Irrigation	58	58	58	58	58	58
Mining	883	1,071	1,282	1,572	1,806	2,076
Livestock	1,544	1,544	1,544	1,544	1,544	1,544
Total	**20,683**	**27,025**	**28,015**	**29,746**	**32,110**	**35,114**

Table 2.16
Adopted Dry-Year Water Demand Projections for Parker County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	30,671	39,528	44,667	55,197	70,446	90,498
Manufacturing	638	729	821	912	1,004	1,095
Steam Electric Power	260	260	260	260	260	260
Irrigation	490	490	490	490	490	490
Mining	3,182	4,029	4,006	4,073	4,124	4,364
Livestock	1,544	1,544	1,544	1,544	1,544	1,544
Total	**36,785**	**46,580**	**51,788**	**62,476**	**77,868**	**98,251**

Table 2.17
Adopted Dry-Year Water Demand Projections for Rockwall County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	19,893	27,064	30,947	36,425	44,054	52,522
Manufacturing	35	40	45	50	55	61
Steam Electric Power	0	0	0	0	0	0
Irrigation	374	374	374	374	374	374
Mining	0	0	0	0	0	0
Livestock	117	117	117	117	117	117
Total	**20,419**	**27,595**	**31,483**	**36,966**	**44,600**	**53,074**

Table 2.18
Adopted Dry-Year Water Demand Projections for Tarrant County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	396,470	443,988	497,892	538,525	575,949	612,536
Manufacturing	20,444	23,630	26,924	29,919	32,457	35,210
Steam Electric Power	2,448	4,168	5,000	5,000	5,000	5,000
Irrigation	4,466	4,466	4,466	4,466	4,466	4,466
Mining	7,367	4,482	1,589	1,537	1,497	1,464
Livestock	723	723	723	723	723	723
Total	**431,918**	**481,457**	**536,594**	**580,170**	**620,092**	**659,399**

Table 2.19
Adopted Dry-Year Water Demand Projections for Wise County by Type of Use

Type of Use	Projected Water Dry-Year Demand (Acre-Feet per Year)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Municipal	12,273	14,677	17,296	23,056	28,741	34,434
Manufacturing	2,660	2,979	3,277	3,539	3,858	4,206
Steam Electric Power	1,494	1,459	2,254	2,450	3,298	3,673
Irrigation	1,324	1,324	1,324	1,324	1,324	1,324
Mining	10,320	11,159	12,337	13,975	15,378	17,694
Livestock	1,575	1,575	1,575	1,575	1,575	1,575
Total	**29,646**	**33,173**	**38,063**	**45,919**	**54,174**	**62,906**

2.2.6 Wholesale Water Provider Projections

Table 2.20 shows the projected dry-year demand in Region C by Wholesale Water Provider, and Appendix H includes details on Wholesale Water Provider demand projections by customer. Appendix H also contains DB17 reports for all Wholesale Water Providers.

Table 2.20
Projected Dry-Year Water Demand by Wholesale Water Provider

Wholesale Water Provider	Projected Dry Year Demand Including Customers (Acre-Feet per Year)					
	2020	2030	2040	2050	2060	2070
Argyle Water Supply Corporation	2,391	3,055	3,956	3,951	3,949	3,948
Arlington	72,206	75,437	76,908	77,603	78,891	79,539
Athens Municipal Water Authority	5,666	5,948	6,189	6,537	9,223	12,533
Corsicana	11,463	17,807	18,795	20,337	22,438	25,114
Cross Timbers Water Supply Corporation	1,819	1,923	1,953	1,988	2,037	2,091
Dallas (Dallas Water Utilities)	517,643	565,386	625,183	690,751	828,677	803,244
Dallas County Park Cities MUD	14,989	15,333	15,249	15,171	15,157	15,156
Denison	8,139	8,942	9,687	10,499	12,106	14,720
Denton	31,160	39,934	49,768	62,433	84,594	102,615
East Cedar Creek FWSD	1,758	1,881	2,116	2,374	3,093	4,301
Ennis	6,656	7,409	8,204	10,859	16,385	26,652
Forney	14,035	14,930	16,556	18,740	22,865	27,672
Fort Worth	292,423	348,026	410,390	455,416	497,352	540,757
Gainesville	3,605	3,302	3,268	3,676	5,129	9,377
Garland	50,966	51,291	51,206	50,878	51,026	51,017
Grand Prairie	43,648	49,316	52,715	52,506	52,484	52,520
Greater Texoma Utility Authority	19,725	37,379	41,883	49,665	67,255	90,350
Lake Cities MUA	2,140	2,406	2,715	2,915	2,909	2,908
Mansfield	36,952	40,363	45,168	53,921	59,704	65,931
Midlothian	12,253	14,020	16,282	18,532	20,748	22,765
Mustang SUD	7,182	12,154	14,554	16,837	19,056	20,723
North Richland Hills	15,632	16,169	15,879	15,718	15,686	15,684
North Texas Municipal Water District	379,792	437,185	505,223	573,182	637,354	699,519
Princeton	1,302	1,606	2,171	4,419	6,605	8,928
Rockett SUD	11,093	13,139	15,547	17,707	21,584	28,888
Rockwall	14,693	20,885	23,543	26,270	30,447	34,678
Sabine River Authority [a]	274,907	234,829	234,750	234,672	234,594	234,515
Seagoville	2,819	3,237	3,775	4,440	5,887	7,603
Sherman	22,932	23,758	25,710	27,994	33,405	42,898

Wholesale Water Provider	Projected Dry Year Demand Including Customers (Acre-Feet per Year)					
	2020	2030	2040	2050	2060	2070
Sulphur River Basin Authority[a]	0	0	0	72,670	127,120	489,800
Sulphur River Municipal Water District [a]	11,356	11,303	11,251	11,198	11,146	11,094
Tarrant Regional Water District	518,015	586,651	660,101	743,607	835,727	949,632
Terrell	5,336	8,721	10,778	13,693	17,152	20,965
Trinity River Authority	204,867	198,487	199,369	205,574	212,053	233,806
Upper Neches Municipal Water Authority [a]	0	110,670	109,563	108,455	107,347	106,239
Upper Trinity Regional Water District	46,264	66,224	84,720	106,619	119,703	135,205
Walnut Creek SUD	2,627	3,210	3,982	5,482	7,952	10,410
Waxahachie	10,649	11,682	15,756	20,480	24,612	29,455
Weatherford	6,340	7,589	9,009	15,444	23,829	34,478
West Cedar Creek MUD	2,542	2,859	3,209	3,681	4,934	6,652
Wise County WSD	3,558	4,321	5,184	7,898	10,230	12,553

(a) These entities are located mostly in other Regions. For Sabine River Authority, demand is for the Dallas and NTMWD from the Upper Basin only (Lake Fork and Lake Tawakoni). For Sulphur River Water District, the demand is for Upper Trinity Regional Water District from Lake Chapman. For Upper Neches Municipal Water Authority, the demand is for Dallas from Lake Palestine. For Sulphur River Basin Authority, the demand is for Tarrant Regional Water District, North Texas Municipal Water District, and Upper Trinity Regional Water District.

CHAPTER 2
LIST OF REFERENCES

(1) United States Bureau of the Census: Census 2010 Data for the State of Texas; Population by County, Population by Place, [Online], Available URL: http://quickfacts.census.gov/, March 2014.

(2) Texas State Data Center and Office of the State Demographer: Texas Population Estimates for 2011, [ONLINE], Available URL: http://txsdc.utsa.edu/Data/TPEPP/Estimates/Index.aspx, March 2014.

(3) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

(4) Texas Water Development Board: 2010 Texas Water Use Summary Estimates for Region C, Austin, [Online], Available URL http://www.twdb.state.tx.us/waterplanning/waterusesurvey/estimates/index.asp downloaded March 12, 2014.

(5) Dallas Morning News: 1998-99 Texas Almanac, Dallas, 1997.

(6) Bureau of Economic Geology in conjunction with Texas Water Development Board: *Current and Projected Water Use in the Texas Mining and Oil and Gas Industry*. June 2011.

(7) Bureau of Economic Geology in conjunction with Texas Water Development Board: Water Demand Projections for Power Generation in Texas. August 31, 2008.

3 Analysis of Water Supply Currently Available to Region C

This section gives an overall summary of the water supplies available to Region C. Appendix I includes further details on the development of this information. Under the Texas Water Development Board (TWDB) regional water planning guidelines [(1)], each region is to identify currently available water supplies to the region by source and user. The supplies available by source are based on the supply available during drought of record conditions. For surface water reservoirs, this is generally the equivalent of firm yield supply or permitted amount (whichever is lower). (Several providers in Region C have chosen to use safe yields as the available supply. The safe yield is less than the firm yield and is discussed in more detail in Section 3.1.) For run-of-the-river supplies, this is the minimum supply available in a month over the historical record. Available groundwater supplies are defined by county and aquifer. Generally, groundwater supply is the supply available with acceptable long-term impacts to water levels. Modeled Available Groundwater (MAG) numbers have been developed by the TWDB to define the long-term available groundwater supply. MAG numbers were not available for "other aquifer." These supply amounts are based on historical pumping data obtained from the TWDB [(3)].

Currently available water supplies are those water supplies that have been permitted or contracted and that have infrastructure in place to transport and treat the water. Some water supplies that are permitted or contracted for use do not yet have the infrastructure in place. Connecting such supplies is considered a water management strategy for use of this water in the future, and water management strategies are discussed in Chapter 5 of this report.

3.1 Overall Water Supply Availability

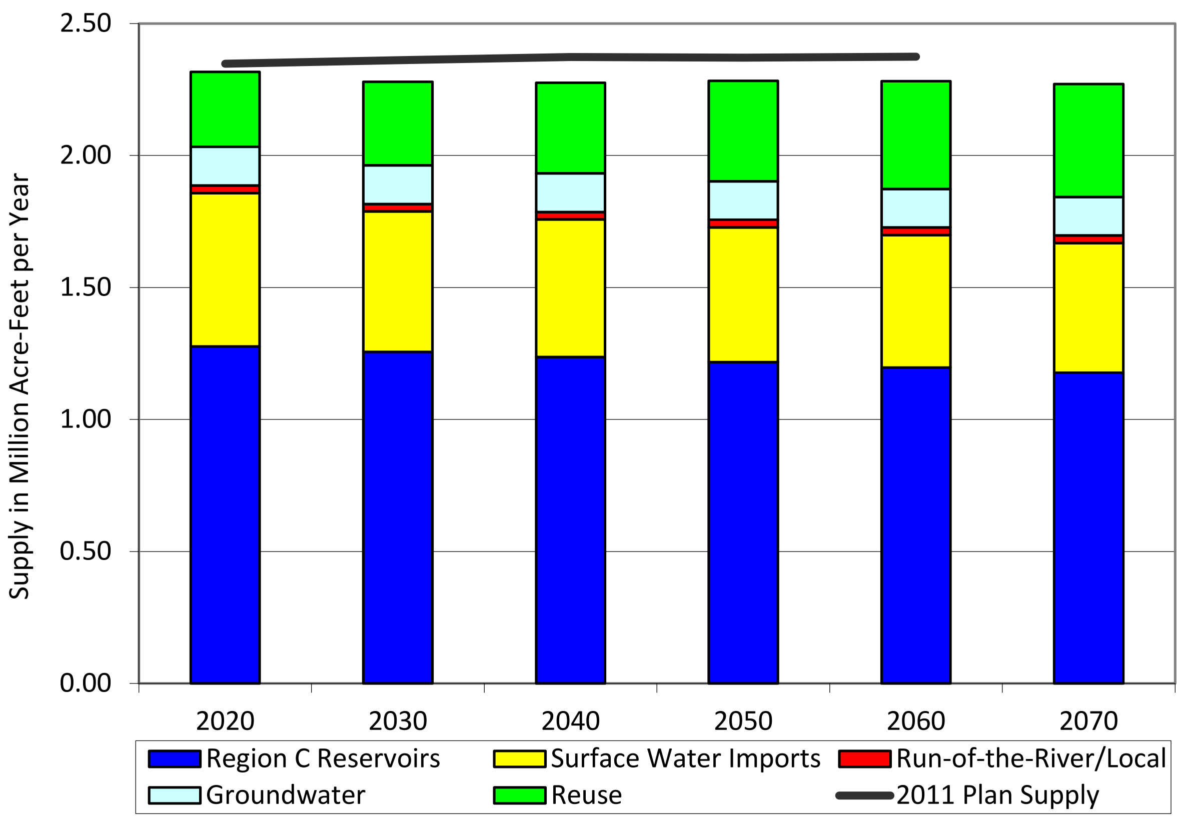
Table 3.1 and Figure 3.1 summarize the overall water supply availability in Region C, including both connected and unconnected water sources. Table 3.1 and Figure 3.1 show that in 2020:

- About 55 percent of the water supply available to Region C is from in-region reservoirs.
- Groundwater is approximately 6 percent of the overall supply available to Region C.
- Local supplies are less than 2 percent of the overall supply available to Region C.

Table 3.1
Overall Water Supply Availability in Region C (Acre-Feet per Year)

Summary	2020	2030	2040	2050	2060	2070
Reservoirs in Region C	1,275,970	1,256,257	1,236,417	1,216,578	1,196,738	1,177,262
Local Irrigation	8,734	8,734	8,734	8,734	8,734	8,734
Other Local Supply	19,931	19,931	19,931	19,931	19,931	19,931
Surface Water Imports	581,567	531,265	520,931	510,717	501,415	491,109
Groundwater	146,178	146,190	146,188	146,135	146,132	146,096
Reuse	283,893	316,972	343,226	380,051	408,880	427,011
REGION C TOTAL	**2,316,273**	**2,279,349**	**2,275,427**	**2,282,147**	**2,281,830**	**2,270,143**

Figure 3.1
Overall Water Supply Availability in Region C



- Currently authorized reuse is about 12 percent of the overall supply available to Region C. (It is worth noting that the development of reuse strategies has increased the 2060 overall reuse available from 336,082 acre-feet per year in the *2011 Region C Water Plan*[2] to 408,880 acre-feet per year in this plan in 2060. Since the *2011 Region C Water Plan* [2], discussions with regional and local water providers led to the identification of several additional large reuse projects. A complete list of the recommended reuse strategies is included in Section 5E. Available reuse quantities are dependent on water use, and as such are subject to reduced supplies from ongoing conservation strategies, but can also increase overtime as water demands increase due to growth.
- Importation of water from other regions is approximately 25 percent of the water available to Region C.
- If all of the available supplies could be utilized, Region C would have 2,270,143 acre-feet per year available in 2070. The total water availability is less than in the *2011 Region C Water Plan* [2] primarily because of lower availability from surface water due to the use of safe yields by some of the larger WWPs. However, this is partially offset some by greater availability from reuse due to the development of new reuse projects.
- Currently connected and available supplies are less than overall water supplies and are discussed in Section 3.4. The sources of the information in Table 3.1 are discussed in greater detail below.

3.2 Surface Water Availability

Reservoirs. In its guidelines for Regional Water Planning [1], the TWDB requires that water availability for reservoirs be based on results of the TCEQ-approved Water Availability Models (WAMs). In Region C, most of the in-region reservoirs are located in the Trinity River Basin. Region C also uses water supplies originating in the Neches, Red, Sabine, Brazos, and Sulphur River Basins.

The WAM models were developed for the purpose of reviewing and granting new surface water right permits. The assumptions in the WAM models are based on the legal interpretation of water rights, and in some cases do not accurately reflect current operations. For planning purposes, adjustments were made to the WAMs to better reflect current and future surface water conditions in the region. Generally, changes made to the WAM included:

- Assessment of reservoir sedimentation rates and calculation of area-capacity conditions for current (2000) and future (2060) conditions.
- Inclusion of subordination agreements.
- Inclusion of system operations where appropriate.
- Other specific corrections by river basin, as appropriate.

These adjustments were approved by the Executive Administrator (EA) of the Texas Water Development Board in a letter to the Chairman of the Region C Water Planning Group, dated December 11, 2012. According to the modified WAM results, the total available supply from Region C reservoirs is calculated at 1,275,970 acre-feet per year in 2020 and 1,177,262 acre-feet per year in 2070. The lower surface water availability compared to the *2011 Region C Water Plan* [(2)] is due to the use of safe yields by some of the larger WWPs. The total available supply from imports from reservoirs in other regions is 581,567 acre-feet per year in 2020 and 491,109 acre-feet per year in 2070. Table 3.2 lists the reservoir water supplies available for use in Region C. More detail on the determination of available supplies from reservoirs is included in Appendix I.

Table 3.2
Surface Water Supplies Currently Available to Region C (Acre-Feet per Year)

Reservoir	Permitted Diversion	2020	2030	2040	2050	2060	2070
Systems in Region C							
Lost Creek/Jacksboro System	1,597	1,597	1,597	1,597	1,597	1,597	1,597
West Fork (includes Bridgeport Local) [(a)]	123,459	96,458	95,625	94,792	93,958	93,125	92,292
Elm Fork/Lewisville/Ray Roberts (Dallas) [(a)]	184,166	172,975	165,580	158,185	150,791	143,396	136,001
Grapevine - Dallas	7,367	7,367	7,150	6,933	6,717	6,500	6,283
Subtotal of Systems in Region C	**316,589**	**278,397**	**269,952**	**261,507**	**253,063**	**244,618**	**236,173**
Reservoirs in Region C							
Cedar Creek [(a)]	175,000	159,367	157,850	156,333	154,817	153,300	151,783
Richland-Chambers (TRWD) [(a)]	210,000	186,600	182,700	178,800	174,900	171,000	167,100
Richland-Chambers (Corsicana)	13,863	13,863	13,855	13,847	13,838	13,830	13,822
Moss	7,410	7,410	7,410	7,410	7,410	7,410	7,410
Lake Texoma (Texas' Share - NTMWD)	190,300	197,000	197,000	197,000	197,000	197,000	197,000
Lake Texoma (Texas' Share - GTUA)	83,200	83,200	83,200	83,200	83,200	83,200	83,200
Lake Texoma (Texas' Share - Denison)	24,400	24,400	24,400	24,400	24,400	24,400	24,400
Lake Texoma (Texas' Share - TXU)	16,400	16,400	16,400	16,400	16,400	16,400	16,400
Lake Texoma (Texas' Share - RRA)	2,250	2,250	2,250	2,250	2,250	2,250	2,250
Randell	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Valley	-	0	0	0	0	0	0
Bonham	5,340	5,340	5,340	5,340	5,340	5,340	5,340
Ray Roberts (Denton)	18,902	18,902	18,733	18,564	18,395	18,226	18,057
Lewisville (Denton)	7,817	7,817	7,715	7,613	7,512	7,410	7,308
Benbrook [(a)]	6,833	5,417	5,400	5,383	5,367	5,350	5,333
Weatherford	2,923	2,923	2,880	2,837	2,793	2,750	2,707
Grapevine (PCMUD)	16,900	16,900	16,750	16,600	16,450	16,300	16,150
Grapevine (Grapevine)	1,983	1,983	1,950	1,917	1,883	1,850	1,817
Arlington [(a)]	9,700	7,667	7,550	7,433	7,317	7,200	7,083

Table 3.2, Continued

Reservoir	Permitted Diversion	2020	2030	2040	2050	2060	2070
Joe Pool	14,883	14,883	14,575	14,267	13,958	13,650	13,342
Mountain Creek	6,400	6,400	6,400	6,400	6,400	6,400	6,400
North	-	0	0	0	0	0	0
Lake Ray Hubbard (Dallas)	56,113	56,113	54,800	53,487	52,173	50,860	49,547
White Rock	3,200	3,200	2,900	2,600	2,300	2,000	1,700
Terrell	2,267	2,267	2,250	2,233	2,217	2,200	2,183
Clark	210	210	210	210	210	210	210
Bardwell	9,600	9,600	9,295	8,863	8,432	8,000	7,931
Waxahachie	2,800	2,800	2,695	2,590	2,485	2,380	2,275
Forest Grove	8,653	8,653	8,590	8,527	8,463	8,400	8,337
Trinidad City Lake	450	450	450	450	450	450	450
Trinidad	3,050	3,050	3,050	3,050	3,050	3,050	3,050
Navarro Mills	18,333	18,333	17,325	16,317	15,308	14,300	13,292
Halbert	-	0	0	0	0	0	0
Fairfield	870	870	870	870	870	870	870
Bryson	-	0	0	0	0	0	0
Mineral Wells	2,495	2,495	2,483	2,470	2,458	2,445	2,433
Teague City Lake	189	189	189	189	189	189	189
Lake Lavon	108,920	108,920	107,140	105,360	103,580	101,800	100,020
Muenster	300	300	300	300	300	300	300
Subtotal of Reservoirs in Region C	**1,033,354**	**997,573**	**986,305**	**974,910**	**963,515**	**952,120**	**941,088**
Imports							
Chapman (NTMWD)	44,792	44,792	44,505	44,218	43,931	43,644	43,357
Chapman (Irving)	42,280	42,280	42,009	41,739	41,468	41,197	40,926
Chapman (Upper Trinity MWD)	12,606	12,606	12,525	12,445	12,364	12,283	12,202
Tawakoni (Dallas)	183,768	174,080	169,120	164,160	159,200	154,240	149,280
Fork (Dallas)	119,699	120,028	116,180	112,332	108,484	104,636	100,788
Upper Sabine (NTMWD)	50,707	50,707	10,629	10,550	10,472	10,394	10,315
Palestine (Dallas)	111,776	111,776	110,670	109,563	108,455	107,347	106,239
Lake Livingston	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Lake Aquilla	276	262	298	340	391	452	523
Lake Granbury	231	276	304	334	368	405	444
Lake Athens (Athens)	5,983	2,432	2,711	2,949	3,293	4,534	4,759
Vulcan Materials (from BRA-Possum Kingdom)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Parker County (from Lake Palo Pinto)	1,257	1,328	1,314	1,302	1,292	1,284	1,276
Subtotal of Imports	**594,375**	**581,567**	**531,265**	**520,931**	**510,717**	**501,415**	**491,109**
TOTAL	**1,944,318**	**1,857,537**	**1,787,522**	**1,757,348**	**1,727,295**	**1,698,153**	**1,668,372**

(a) Amounts reported are safe yields.

Local Irrigation Supply. The local irrigation surface water supply is based on existing run-of-the-river water rights for irrigation not associated with major reservoirs. The total irrigation local supply in Region

C is estimated at 8,734 acre-feet per year throughout the planning period. More detail on the determination of available supplies for run-of-the-river supply is shown in Table 3.3 and in Appendix I.

Other Local Supplies. Other local supplies include run-of-the-river supplies associated with water rights and used for municipal, manufacturing, mining, and power generation. They also include local surface water supplies used for mining and livestock. For livestock and mining local supplies, some of the available supplies were revised considering the historical use over the past ten years (4), 2011 use (4), and projected demands. The total other local supply available in Region C is 17,974 acre-feet per year. More detail on the determination of available other local supplies is included in Table 3.3 and Appendix I.

Table 3.3
Run-of-the-River and Other Local Water Supplies

County	Run-of-the-River Supply (Acre-Feet per Year)				Other Local Supply (Acre-Feet per Year)	
	Irrigation	Manufacturing	Mining	Municipal	Livestock	Mining
Collin	408	0	0	0	1,002	0
Cooke	0	0	0	0	1,187	0
Dallas	791	368	0	0	198	1,525
Denton	0	0	0	0	622	0
Ellis	3	0	0	0	1,112	0
Fannin	4,613	0	72	69	1,306	0
Freestone	87	0	0	41	1,043	120
Grayson	1,091	30	0	0	1,075	0
Henderson	415	0	0	0	341	0
Jack	110	0	0	0	802	370
Kaufman	64	0	0	0	1,622	86
Navarro	226	0	0	252	1,603	0
Parker	239	0	0	33	1,922	20
Rockwall	0	0	0	0	117	0
Tarrant	549	959	0	0	442	342
Wise	139	0	133	0	1,117	0
TOTAL	**8,734**	**1,357**	**205**	**395**	**15,511**	**2,463**

Reuse. The reuse supply considered as available to the region is from existing projects based on current permits, authorizations, and facilities. Categories of reuse include (1) currently permitted and operating indirect reuse projects, in which water is reused after being returned to the stream; (2) existing reuse projects for industrial purposes (including recycled water for mining use); and (3) authorized direct reuse projects for which facilities are already developed. The specific reuse projects included are discussed in Appendix I.

Indirect reuse project sponsors in Region C include the North Texas Municipal Water District (NTMWD), Trinity River Authority (TRA), Tarrant Regional Water District (TRWD), the Upper Trinity Regional Water District (UTRWD), Dallas Water Utilities (DWU), Denton, and Grapevine. In addition, there are a number of existing direct reuse projects for landscape irrigation, golf course irrigation, cooling water, park irrigation, and natural gas industry use in Region C. Many of these projects were included in the *2011 Region C Water Plan* (2). Significant new reuse projects since the 2011 plan include:

- The expansion of the City of Fort Worth's Village Creek Reclaimed Water Delivery System to serve the Cities of Arlington and Euless, Dallas-Fort Worth International Airport, and other potential retail customers within the City of Fort Worth.
- The TRWD Richland-Chambers Reservoir reuse project began operation in 2009 and diverts return flows into off-channel, wetland impoundments for water quality treatment purposes before delivery into the Richland-Chambers Reservoir for storage and diversion. The project was expanded in 2013, and water right permits were amended in December 2014 to increase the supply available from this WMS.
- Dallas Water Utilities and NTMWD have entered into an agreement which would allow NTMWD to exchange return flows from its WWTPs discharging into Lake Ray Hubbard for Dallas return flows discharged to the main stem of the Trinity River. Under this agreement, Dallas will obtain the right to divert the NTMWD return flows from Lake Ray Hubbard and will pump an equal amount of flow from the main stem of the Trinity River to the NTMWD East Fork Water Supply Project wetland for use by NTMWD. In addition, once water rights for Elm Fork return flows (from NTMWD WWTPs discharging to Lake Lewisville) have been secured by NTMWD, NTMWD will support Dallas efforts to secure bed and banks transport, storage and diversion rights for the Elm Fork return flows. In exchange, Dallas will pump a quantity equal to NTMWD's discharge of its future Elm Fork return flows to the East Fork Water Supply Project wetland for use by NTMWD.

It is anticipated that reuse will increase significantly in Region C over the next 50 years, but proposed and potential reuse projects are not included as currently available supplies. There are a number of reuse projects being considered as potentially feasible management strategies as part of this planning process. Recommended water management strategies for reuse are discussed in Chapter 5 of this report.

Table 3.4 summarizes the currently permitted reuse supplies by county in Region C. The total available supply from reuse in Region C by 2020 is 283,893 acre-feet per year, increasing to 427,011 acre-feet per year in 2070.

Table 3.4
Currently Permitted Reuse Supplies by County (Acre-Feet per Year)

County	2020	2030	2040	2050	2060	2070
Collin	49,722	58,690	66,089	74,186	74,186	74,186
Cooke	9	9	9	9	9	9
Dallas	9,246	9,246	9,246	9,246	9,246	9,246
Denton	47,669	55,677	61,106	77,568	96,221	111,118
Ellis	4,388	4,791	5,523	6,038	6,038	6,038
Fannin	0	0	0	0	0	0
Freestone	0	0	0	0	0	0
Grayson	0	0	0	0	0	0
Henderson	32	32	32	32	32	32
Jack	27	26	26	25	25	24
Kaufman	57,328	72,606	85,261	97,028	107,392	110,627
Navarro	100,465	100,465	100,465	100,465	100,465	100,465
Parker	97	97	97	97	97	97
Rockwall	672	672	672	672	672	672
Tarrant	7,977	8,400	8,439	8,424	8,421	8,421
Wise	6,261	6,261	6,261	6,261	6,076	6,076
TOTAL	**283,893**	**316,972**	**343,226**	**380,051**	**408,880**	**427,011**

3.3 Groundwater Availability

Groundwater supplies in Region C are obtained from two major aquifers (Carrizo-Wilcox and Trinity), three minor aquifers (Woodbine, Nacatoch, and Queen City), and locally undifferentiated formations, referred to as "other aquifer".

The TWDB guidelines [(1)] state that Modeled Available Groundwater (MAG) estimates provided by the TWDB are to be used to determine available groundwater supplies. MAG estimates are developed by the TWDB using Desired Future Conditions (DFCs) submitted by Groundwater Management Areas (GMAs). The TWDB created sixteen GMAs in Texas. GMA 8 covers all of Region C except for Jack County, Henderson County, and a small portion of Navarro County. The GMAs are responsible for developing DFCs for aquifers within their respective areas. The TWDB quantifies MAG estimates based on the DFCs provided by the GMAs.

Trinity and Woodbine Aquifers. The Woodbine aquifer overlies the Trinity aquifer. The Woodbine aquifer is in Collin, Cooke, Dallas, Denton, Ellis, Fannin, Grayson, Kaufman, Navarro, Rockwall, and Tarrant counties in Region C. The Trinity aquifer is in Collin, Cooke, Dallas, Denton, Ellis, Fannin, Grayson, Jack, Kaufman, Navarro, Parker, Rockwall, Tarrant, and Wise counties in Region C. Most of the pumping from the Trinity aquifer in Region C is from three layers: Paluxy, Hensel, and Hosston. MAG estimates provided by the TWDB were used to determine groundwater availability from the Trinity and Woodbine aquifers. These availability numbers are shown in Table 3.5.

Carrizo-Wilcox, Queen City, and Nacatoch Aquifers. Supplies from the Carrizo-Wilcox aquifer are available in Freestone, Henderson, and Navarro counties in Region C. Supplies from the Queen City aquifer are available in Henderson County in Region C. The Nacatoch aquifer underlies Kaufman, Henderson, and Navarro counties in Region C. MAG estimates provided by the TWDB were used to determine groundwater availability from the Carrizo-Wilcox, Queen City, and Nacatoch aquifers. Table 3.5 shows the groundwater availability by county to Region C from these aquifers. As with reservoirs, this number represents the amount of water available from the aquifer, without considering limitations imposed by, or current availability due to, the capacity of wells and other facilities. The amount of groundwater currently available in Region C is discussed in Section 3.4.

Other Aquifers. There are several locally undifferentiated formations in Region C, referred to as "other aquifer." Other aquifer supplies are used in Fannin, Jack, and Parker counties in Region C. Available supplies from these undifferentiated formations are not included in the MAG numbers. The Other aquifer available supply amounts are based on historical use. In the historical pumping data obtained from the TWDB, there are significant amounts of groundwater classified as "other aquifer" or "unknown aquifer". In many cases, it is believed the "other aquifer" use should be classified as part of a differentiated formation but was not. In these cases, other aquifer supplies were not shown to be available despite the "availability" shown in the historical data.

Groundwater Conservation Districts. There are currently seven Groundwater Conservation Districts (GCDs) that include one or more Region C counties:

- Upper Trinity GCD (Wise and Parker Counties)
- Northern Trinity GCD (Tarrant County)
- Neches and Trinity Valleys GCD (includes Henderson County
- Mid-East Texas GCD (includes Freestone County)
- Prairielands GCD (includes Ellis County)
- North Texas GCD (Collin, Cooke, and Denton Counties)
- Red River GCD (Grayson and Fannin Counties).

Summary. In Region C, MAG estimates for the Trinity, Woodbine, Carrizo-Wilcox, Nacatoch, and Queen City aquifers were available for this cycle of regional water planning. MAG estimates were not available for other aquifers, and groundwater supplies were based on historical pumping information from the TWDB [(3)]. The total available supply from groundwater in Region C is 146,178 acre-feet per year in 2020, decreasing very slightly to 146,096 acre-feet per year in 2070. More detail on the determination of available supplies from groundwater is included in Appendix I.

3.4 Currently Available Water Supplies

Table 3.6 and Figure 3.2 show the currently available water supplies in Region C by different source types. Table 3.7 shows the currently available supplies for water user groups by county. Currently available supplies are supplies that can be used with currently existing water rights, contracts, and facilities. They are less than the overall supplies available to the region because the facilities needed to use some supplies have not yet been developed. (Common constraints limiting currently available supplies include the availability and capacity of transmission systems, treatment plants, and wells.) The comparison of overall water supply availability and currently available water supplies for Region C shows the following:

The total currently available supply in Region C for 2070 is over 1.63 million acre-feet per year, of which approximately 1.62 million acre-feet per year is available to users in Region C. (A portion is used to supply customers in adjacent regions.) This is approximately 640,000 acre-feet per year less than the overall supply. The difference is due primarily to transmission and treatment plant capacity limitations. The currently available supply presented in this plan is less than what was in the 2011 Region C Plan. This is mainly due to the decreased yield of Chapman Lake using the new critical period of the reservoir and decreased supplies available to TRWD and DWU because of the use of safe yields.

The currently available supplies from in-region reservoirs, local sources, groundwater and current reuse are nearly fully allocated by 2070. Some of the small amount of available supplies not allocated can be attributed to sources that are not currently used for water supply (White Rock Lake, Lake Mineral Wells and Forest Grove Reservoir).

Groundwater supplies, which represent approximately 6 percent of the total available supply to the region, are over 86 percent utilized by current water users. The total amount of groundwater supply that is available for future allocation is around 20,000 acre-feet per year.

Table 3.5
Groundwater Supplies in Region C (Acre-Feet per Year)

Aquifer	County	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox	Freestone	5,305	5,317	5,315	5,262	5,259	5,223
Carrizo-Wilcox	Henderson	5,187	5,187	5,187	5,187	5,187	5,187
Carrizo-Wilcox	Navarro	15	15	15	15	15	15
Carrizo-Wilcox Subtotal		**10,507**	**10,519**	**10,517**	**10,464**	**10,461**	**10,425**
Trinity	Collin	2,104	2,104	2,104	2,104	2,104	2,104
Trinity	Cooke	6,850	6,850	6,850	6,850	6,850	6,850
Trinity	Dallas	5,458	5,458	5,458	5,458	5,458	5,458
Trinity	Denton	19,333	19,333	19,333	19,333	19,333	19,333
Trinity	Ellis	3,959	3,959	3,959	3,959	3,959	3,959
Trinity	Fannin	700	700	700	700	700	700
Trinity	Grayson	9,400	9,400	9,400	9,400	9,400	9,400
Trinity	Kaufman	1,181	1,181	1,181	1,181	1,181	1,181
Trinity	Navarro	1,873	1,873	1,873	1,873	1,873	1,873
Trinity	Parker	15,248	15,248	15,248	15,248	15,248	15,248
Trinity	Rockwall	958	958	958	958	958	958
Trinity	Tarrant	18,747	18,747	18,747	18,747	18,747	18,747
Trinity	Wise	9,282	9,282	9,282	9,282	9,282	9,282
Trinity Subtotal		**95,093**	**95,093**	**95,093**	**95,093**	**95,093**	**95,093**
Woodbine	Collin	2,509	2,509	2,509	2,509	2,509	2,509
Woodbine	Cooke	154	154	154	154	154	154
Woodbine	Dallas	2,313	2,313	2,313	2,313	2,313	2,313
Woodbine	Denton	4,126	4,126	4,126	4,126	4,126	4,126
Woodbine	Ellis	5,441	5,441	5,441	5,441	5,441	5,441
Woodbine	Fannin	3,297	3,297	3,297	3,297	3,297	3,297
Woodbine	Grayson	12,087	12,087	12,087	12,087	12,087	12,087
Woodbine	Kaufman	200	200	200	200	200	200
Woodbine	Navarro	300	300	300	300	300	300
Woodbine	Rockwall	144	144	144	144	144	144
Woodbine	Tarrant	632	632	632	632	632	632
Woodbine Subtotal		**31,203**	**31,203**	**31,203**	**31,203**	**31,203**	**31,203**
Nacatoch	Ellis, Kaufman, Navarro & Rockwall	1,939	1,939	1,939	1,939	1,939	1,939
Queen City	Henderson	3,533	3,533	3,533	3,533	3,533	3,533
Other	Fannin, Jack & Parker	3,903	3,903	3,903	3,903	3,903	3,903
Minor Aquifers		**9,375**	**9,375**	**9,375**	**9,375**	**9,375**	**9,375**
TOTAL		**146,178**	**146,190**	**146,188**	**146,135**	**146,132**	**146,096**

Permitted surface water imports to Region C are shown to be more than 490,000 acre-feet per year in 2070 in Table 3.1. Approximately 35% of these supplies are not currently connected to water supply systems. The connection of these supplies will be considered as water management strategies in Chapter 5.

Table 3.6
Currently Available Water Supplies to Water Users by Source Type (Acre-Feet per Year)

Category	2020	2030	2040	2050	2060	2070
Reservoirs in Region C	886,705	867,806	846,882	821,182	790,709	764,669
Local Irrigation	8,734	8,734	8,734	8,734	8,734	8,734
Other Local Supply	19,931	19,931	19,931	19,931	19,931	19,931
Surface Water Imports	404,146	366,991	356,811	344,731	331,295	318,991
Groundwater	126,536	125,997	126,061	126,055	125,994	125,890
Reuse	238,392	273,610	300,197	338,985	372,203	393,126
REGION C TOTAL	**1,684,444**	**1,663,069**	**1,658,616**	**1,659,618**	**1,648,866**	**1,631,341**

Figure 3.2
Currently Available Supplies to Region C Water Users

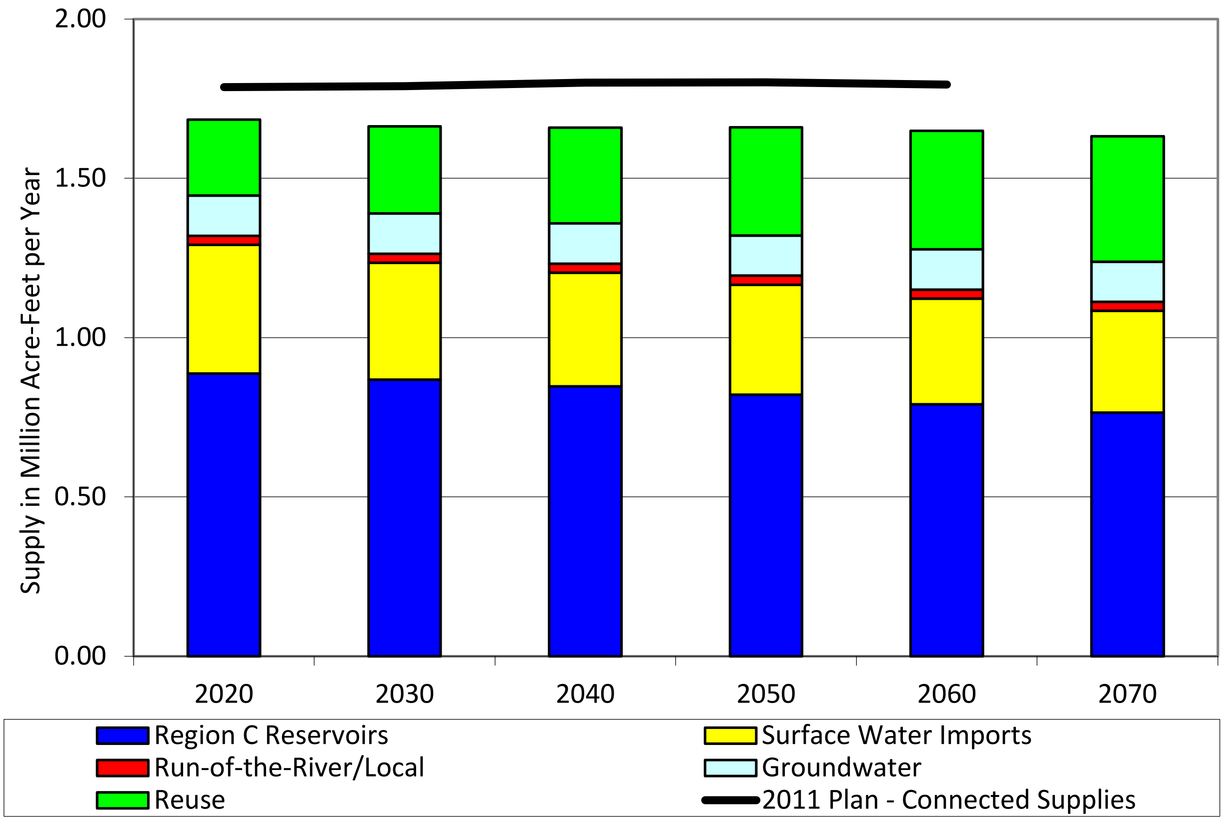


Table 3.7
Currently Available Supplies by County (Acre-Feet per Year)

County	2020	2030	2040	2050	2060	2070
Collin	208,371	194,592	205,058	214,835	212,778	210,786
Cooke	10,797	10,791	10,671	10,817	11,084	11,516
Dallas	540,547	521,951	513,314	512,811	508,126	499,805
Denton	177,718	183,333	181,707	178,612	178,750	176,565
Ellis	45,729	46,073	46,362	50,490	52,275	55,445
Fannin	21,878	22,562	22,562	22,562	22,562	22,561
Freestone	34,187	33,537	32,819	32,197	31,663	31,184
Grayson	47,102	47,243	47,381	47,528	48,586	48,868
Henderson	13,519	13,566	13,501	13,501	14,253	14,699
Jack	6,089	6,169	5,933	5,766	5,624	5,524
Kaufman	30,990	32,585	34,110	36,550	40,993	44,124
Navarro	14,652	11,617	11,563	11,651	11,859	11,940
Parker	37,324	43,158	44,216	46,127	45,747	44,910
Rockwall	19,285	21,674	22,757	25,083	28,253	31,044
Tarrant	431,840	429,320	420,714	404,815	389,351	374,983
Wise	28,485	29,302	30,296	31,223	31,880	32,023
Subtotal	**1,668,513**	**1,647,473**	**1,642,964**	**1,644,568**	**1,633,784**	**1,615,977**
Other Regions	15,931	15,596	15,652	15,050	15,082	15,364
TOTAL	**1,684,444**	**1,663,069**	**1,658,616**	**1,659,618**	**1,648,866**	**1,631,341**

3.5 Water Availability by Wholesale Water Provider (WWP)

As part of the Senate Bill One planning process, the Texas Water Development Board requires development of water availability for each designated wholesale water provider. A wholesale water provider is defined as "any person or entity, including river authorities and irrigation districts that has contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last Regional Water Plan." (1) The planning groups are also required to designate any person or entity expected to contract to sell at least 1,000 acre-feet per year of wholesale water during the planning period as a WWP. There are 41 entities in Region C that qualify as wholesale water providers (21 cities, 3 river authorities, and 17 water districts). Thirteen of the wholesale water providers provide a large amount of wholesale water supplies to a number of customers and are considered "regional" wholesale water providers. Table 3.8 gives a summary of the supplies currently available to regional wholesale water providers. The remaining 28 WWPs supply less water to fewer customers and are considered local wholesale water providers. Table 3.9 gives a summary of the supplies currently available to local wholesale water providers serving Region C. As discussed in Section 3.4, currently available supplies are limited by existing physical facilities.

Table 3.8
Currently Available Supplies to Regional Wholesale Water Providers in Region C

Provider	Source	Water Supply Currently Available (Acre-Feet per Year)					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Dallas Water Utilities	Ray Roberts/Lewisville System[a]	172,975	165,580	158,185	150,791	143,396	136,001
	Lake Grapevine	7,367	7,150	6,933	6,717	6,500	6,283
	Lake Ray Hubbard	56,113	54,800	53,487	52,173	50,860	49,547
	Lake Tawakoni[a]	174,080	169,120	164,160	159,200	154,240	149,280
	Lake Fork[a]	50,120	55,080	60,040	65,000	69,960	74,920
	Direct Reuse (Cedar Crest GC)	1,121	1,121	1,121	1,121	1,121	1,121
	Indirect Reuse	32,550	38,223	41,048	55,000	73,091	87,511
	White Rock Lake (Irrigation Only)	3,200	2,900	2,600	2,300	2,000	1,700
	DWU Total	**497,526**	**493,974**	**487,574**	**492,302**	**501,168**	**506,363**
Tarrant Regional Water District[a]	West Fork System	96,458	95,625	94,792	93,958	93,125	92,292
	Lake Benbrook	5,417	5,400	5,383	5,367	5,350	5,333
	Lake Arlington	7,667	7,550	7,433	7,317	7,200	7,083
	Cedar Creek Lake	126,731	127,267	128,018	129,208	131,932	135,885
	Richland-Chambers Reservoir	186,600	182,700	178,800	174,900	171,000	167,100
	Richland-Chambers Reuse	61,831	65,731	69,631	73,531	77,431	81,331
	TRWD Total	**484,704**	**484,273**	**484,057**	**484,281**	**486,038**	**489,024**
North Texas Municipal Water District	Lake Lavon	86,500	85,900	85,300	84,700	84,100	83,500
	Lake Texoma	70,623	70,623	70,623	70,623	70,623	70,623
	Chapman Lake	41,172	40,982	40,792	40,602	40,412	40,222
	Wilson Creek Reuse	47,418	56,386	63,785	71,882	71,882	71,882
	Lake Bonham	2,511	3,195	3,195	3,195	3,195	3,195
	East Fork Reuse	47,802	62,977	75,524	87,291	97,655	100,890
	Upper Sabine Basin	50,707	10,629	10,550	10,472	10,394	10,315
	Direct Reuse	2,519	2,519	2,519	2,519	2,519	2,519
	NTMWD Total	**349,252**	**333,211**	**352,288**	**371,284**	**380,780**	**383,146**
City of Fort Worth	TRWD Supplies	275,830	278,569	278,569	278,569	278,569	278,569
	Direct Reuse	4,366	4,423	4,423	4,423	4,423	4,423
	Fort Worth Total	**280,196**	**282,992**	**282,992**	**282,992**	**282,992**	**282,992**

Table 3.8, Continued

Provider	Source	Water Supply Currently Available (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
Sabine River Authority	Lake Tawakoni (Dallas)	174,080	169,120	164,160	159,200	154,240	149,280
	Lake Tawakoni (NTMWD)	30,707	10,629	10,550	10,472	10,394	10,315
	Lake Tawakoni (Others)	35,235	34,977	34,720	34,462	34,204	33,947
	Lake Fork (Dallas)	120,028	116,180	112,332	108,484	104,636	100,788
	Lake Fork (Others)	14,895	37,632	40,369	43,106	45,844	48,581
	Subtotal Upper Basin	**374,945**	**368,538**	**362,131**	**355,724**	**349,318**	**342,911**
	Toledo Bend Lake	750,000	750,000	750,000	750,000	750,000	750,000
	Sabine Run-of-River	147,100	147,100	147,100	147,100	147,100	147,100
	SRA Total	**1,272,045**	**1,265,638**	**1,259,231**	**1,252,824**	**1,246,418**	**1,240,011**
Trinity River Authority	Joe Pool Lake (Midlothian)	5,833	5,712	5,591	5,470	5,349	5,229
	Joe Pool Lake (Grand Prairie)	1,272	1,239	1,207	1,174	1,141	1,109
	Joe Pool Lake (Grand Prairie Raw)	300	300	300	300	300	300
	Navarro Mills Lake	18,333	17,325	16,317	15,308	14,300	13,292
	Bardwell Lake	9,600	9,295	8,863	8,432	8,000	7,931
	Lake Livingston (Region C)	20,000	20,000	20,000	20,000	20,000	20,000
	Reuse (Region C)	11,604	12,007	12,739	13,254	13,254	13,254
	Subtotal	**66,942**	**65,878**	**65,017**	**63,938**	**62,344**	**61,115**
	TRWD	61,449	61,182	57,735	57,970	57,033	53,881
	TRA Total in Region C	**128,391**	**127,060**	**122,752**	**121,908**	**119,377**	**114,996**
Upper Neches River Municipal Water Authority	Lake Palestine (Dallas) [b]	111,694	110,589	109,484	108,378	107,270	106,164
	Lake Palestine (Other Committed)	93,723	92,786	91,849	90,914	89,980	89,065
	UNRMWA Total	**205,417**	**203,375**	**201,333**	**199,292**	**197,250**	**195,229**
Upper Trinity Regional Water District	Chapman Lake	11,356	11,303	8,438	8,399	8,360	5,547
	DWU Contract	37,307	40,513	37,930	35,231	33,087	31,490
	Chapman Reuse	5,435	5,575	4,287	4,392	4,497	3,068
	Direct Reuse	897	897	897	897	897	897
	UTRWD Total	**54,995**	**58,288**	**51,552**	**48,919**	**46,841**	**41,002**

Table 3.8, Continued

Provider	Source	Water Supply Currently Available (Acre-Feet per Year)					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Sulphur River Basin Authority	None	0	0	0	0	0	0
Sulphur River Municipal Water District	Chapman Lake (UTRWD)	11,588	11,534	11,481	11,427	11,374	11,320
	Chapman Lake (NTMWD through Cooper)	2,309	2,299	2,288	2,277	2,267	2,256
	Chapman Lake (Other)	13,811	13,747	13,684	13,620	13,556	13,492
	SRWD Total	**27,708**	**27,580**	**27,452**	**27,324**	**27,196**	**27,068**
	SRWD to Region C	**13,897**	**13,833**	**13,769**	**13,704**	**13,640**	**13,576**
Dallas County Park Cities MUD	Lake Grapevine	16,900	16,750	16,600	16,450	16,300	16,150
	Grapevine Reuse	3,311	3,677	3,716	3,701	3,698	3,698
	DCPCMUD Total	**20,211**	**20,427**	**20,316**	**20,151**	**19,998**	**19,848**
Greater Texoma Utility Authority	Lake Texoma Raw Water	83,200	83,200	83,200	83,200	83,200	83,200
	Delivery Limited by WTP Capacity	11,210	11,210	11,210	11,210	11,210	11,210
	Usable Lake Texoma Raw Water	71,990	71,990	71,990	71,990	71,990	71,990
	Denison (for Pottsboro)	362	492	560	560	560	560
	NTMWD (Collin-Grayson MA)	1,661	2,160	3,375	5,400	5,400	5,400
	GTUA Total	**85,223**	**85,852**	**87,135**	**89,160**	**89,160**	**89,160**
City of Corsicana	Navarro Mills Lake (from TRA)	17,828	17,325	16,317	15,308	14,300	13,292
	Richland Chambers and Halbert	13,863	13,855	13,847	13,838	13,830	13,822
	Total (Limited by WTP Capacity)	**13,452**	**13,452**	**13,452**	**13,452**	**13,452**	**13,452**

[a] The available supply reported is the safe yield because of the operations by the WWP.

[b] The contract amount with Dallas is for 114,342 acre-feet/year. The amounts shown above are based on the firm yield available to Dallas.

Table 3.9
Currently Available Supplies to Local Wholesale Water Providers in Region C

Provider	Source	Water Supply Currently Available (Acre-Feet per Year)					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Argyle WSC	Groundwater	950	950	950	950	950	950
	UTRWD	1,441	1,732	1,962	1,603	1,464	1,284
	Total	**2,391**	**2,682**	**2,912**	**2,553**	**2,414**	**2,234**
Arlington	Fort Worth (Reuse)	178	178	178	178	178	178
	TRWD	72,028	68,467	61,699	55,011	49,884	44,891
	Total	**72,206**	**68,645**	**61,877**	**55,189**	**50,062**	**45,069**
Athens Municipal Water Authority	Lake Athens (firm yield)	5,983	5,903	5,822	5,741	5,660	5,580
	Lake Athens (operational yield)	2,900	2,900	2,900	2,900	2,900	2,900
	Groundwater	966	966	966	966	966	966
	Total	**6,949**	**6,869**	**6,788**	**6,707**	**6,626**	**6,546**
Cross Timbers WSC	UTRWD	1,019	947	805	696	675	612
	Trinity Aquifer	800	800	800	800	800	800
	Total	**1,819**	**1,747**	**1,605**	**1,496**	**1,475**	**1,412**
Dallas County Park Cities MUD	Lake Grapevine	16,900	16,750	16,600	16,450	16,300	16,150
	Reuse	3,311	3,677	3,716	3,701	3,698	3,698
	Total	**20,211**	**20,427**	**20,316**	**20,151**	**19,998**	**19,848**
Denison	Lake Randall	1,400	1,400	1,400	1,400	1,400	1,400
	Lake Texoma (water right)	24,400	24,400	24,400	24,400	24,400	24,400
	Lake Texoma (contracted with GTUA)	12,204	12,204	12,204	12,204	12,204	12,204
	Groundwater	121	121	121	121	121	121
	Total (limited by WTP capacity)	**8,144**	**8,207**	**8,267**	**8,318**	**8,396**	**8,480**

Table 3.9, Continued

Provider	Source	Water Supply Currently Available (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
Denton	Lake Lewisville	7,817	7,715	7,613	7,512	7,410	7,308
	Lake Ray Roberts	18,902	18,733	18,564	18,395	18,226	18,057
	Indirect Reuse	6,775	8,729	10,922	12,953	12,818	12,683
	DWU	0	2,301	7,735	14,433	27,839	37,545
	Subtotal (limited by WTP capacity)	**26,904**	**26,904**	**26,904**	**26,904**	**26,904**	**26,904**
	Reuse (Steam Electric Power and Irrigation)	1,052	1,139	1,225	1,312	1,399	1,494
	Total	**27,956**	**28,043**	**28,129**	**28,216**	**28,303**	**28,398**
East Cedar Creek FWSD	**TRWD (limited by contract)**	**1,758**	**1,712**	**1,702**	**1,687**	**1,961**	**2,434**
Ennis	Bardwell Lake (TRA)	5,200	5,035	4,801	4,567	4,333	4,296
	TRA (TRWD Sources)	379	946	1,173	2,309	3,934	3,991
	Rockett SUD	12	9	8	6	5	3
	Direct Reuse	909	909	909	909	909	909
	Total (limited by WTP capacity)	**6,500**	**6,899**	**6,891**	**7,641**	**7,640**	**7,638**
Forney	NTMWD	6,593	6,168	6,834	7,896	9,973	10,978
	Reuse from Garland (Steam Electric only)	6,879	6,879	6,879	6,879	6,879	6,879
	Total	**13,471**	**13,047**	**13,713**	**14,775**	**16,852**	**17,857**
Gainesville	Trinity Aquifer	2,104	2,104	2,104	2,104	2,104	2,104
	Moss Lake (limited by WTP)	2,242	2,242	2,242	2,242	2,242	2,242
	Direct Reuse	9	9	9	9	9	9
	Total	**4,355**	**4,355**	**4,355**	**4,355**	**4,355**	**4,355**

Table 3.9, Continued

Provider	Source	Water Supply Currently Available (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
Garland	NTMWD	38,683	32,422	29,823	27,893	26,233	24,277
	Reuse sold to Forney (Steam Electric only)	8,979	8,979	8,979	8,979	8,979	8,979
	Total	**47,662**	**41,401**	**38,802**	**36,872**	**35,212**	**33,256**
Grand Prairie	Groundwater	4,200	4,200	4,200	4,200	4,200	4,200
	Joe Pool Raw Water	300	300	300	300	300	300
	Fort Worth (TRWD)	2,752	2,260	1,916	1,725	1,579	1,451
	Midlothian (Joe Pool)	3,363	3,363	3,363	3,363	3,363	3,363
	Mansfield (TRWD)	3,363	3,363	3,363	3,146	2,841	2,573
	DWU	23,966	26,712	26,052	23,869	21,938	20,918
	Total	**37,944**	**40,198**	**39,194**	**36,603**	**34,221**	**32,805**
Lake Cities MUA	UTRWD	1,785	1,642	1,492	1,299	1,169	1,024
	Groundwater	355	355	355	355	355	355
	Total	**2,140**	**1,997**	**1,847**	**1,654**	**1,524**	**1,379**
Mansfield	**TRWD**	**25,223**	**25,223**	**25,223**	**25,223**	**25,223**	**25,223**
Midlothian	TRA (TRWD)	4,870	5,045	5,045	5,045	5,045	5,045
	Joe Pool Lake (TRA)	5,833	5,712	5,591	5,470	5,349	5,229
	Total (limited by WTP capacity)	**10,703**	**10,757**	**10,636**	**10,515**	**10,394**	**10,274**
Mustang SUD	Trinity Aquifer	1,104	1,104	1,104	1,104	1,104	1,104
	Woodbine Aquifer	71	71	71	71	71	71
	UTRWD Sources	6,007	8,734	8,357	7,800	7,957	7,607
	Total	**7,182**	**9,909**	**9,532**	**8,975**	**9,132**	**8,782**
North Richland Hills	TRWD (through Ft Worth)	6,053	6,053	6,053	6,053	6,053	5,872
	TRWD (through TRA)	4,244	4,058	3,532	3,094	2,755	2,459
	Total	**10,298**	**10,111**	**9,585**	**9,147**	**8,808**	**8,331**

Table 3.9, Continued

Provider	Source	Water Supply Currently Available (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
Princeton	**NTMWD**	**1,200**	**1,231**	**1,533**	**2,942**	**4,121**	**5,156**
Rockett SUD	Midlothian	2,118	1,738	1,382	1,141	969	848
	TRA (TRWD Sources)	6,781	6,781	6,781	6,781	6,781	6,781
	Sokoll WTP Capacity (TRWD Sources)	5,605	5,605	5,605	5,605	5,605	5,605
	Total	**7,723**	**7,343**	**6,987**	**6,746**	**6,574**	**6,453**
Rockwall	**NTMWD**	**13,537**	**16,003**	**16,627**	**17,488**	**18,995**	**20,027**
Seagoville	DWU Sources	2,404	2,396	2,453	2,595	3,230	4,247
	DWU Sources Limited by Contract	1,682	1,682	1,682	1,682	1,682	1,682
	Total	**1,682**	**1,682**	**1,682**	**1,682**	**1,682**	**1,682**
Sherman	Trinity Aquifer	4,083	4,083	4,083	4,083	4,083	4,083
	Woodbine Aquifer	1,289	1,289	1,289	1,289	1,289	1,289
	GTUA treated (limited by WTP)	11,210	11,210	11,210	11,210	11,210	11,210
	GTUA raw water (for SEP demand)	6,163	6,163	6,163	6,163	6,163	6,163
	Total	**22,745**	**22,745**	**22,745**	**22,745**	**22,745**	**22,745**
Terrell	**NTMWD**	**4,915**	**6,682**	**6,726**	**6,726**	**6,726**	**6,726**
Walnut Creek SUD	TRWD	2,627	2,922	3,203	3,897	4,480	4,480
	Total (limited by WTP capacity)	**2,627**	**2,922**	**3,203**	**3,897**	**4,480**	**4,480**
Waxahachie	Lake Waxahachie	2,800	2,695	2,590	2,485	2,380	2,275
	TRA (Bardwell)	4,320	4,183	3,989	3,794	3,600	3,569
	Rockett SUD (for retail connections)	427	343	275	234	187	137
	Reuse	3,479	3,882	4,614	5,129	5,129	5,129
	TRA (TRWD Sources for Sokoll WTP)	2,500	2,275	2,011	4,419	5,212	5,212
	Total	13,526	13,378	13,479	16,061	16,508	16,322
	Total (limited by WTP capacity)	**13,016**	**12,707**	**12,375**	**14,742**	**15,488**	**15,438**

Table 3.9, Continued

Provider	Source	Water Supply Currently Available (Acre-Feet per Year)					
		2020	2030	2040	2050	2060	2070
Weatherford	Lake Weatherford	2,923	2,880	2,837	2,793	2,750	2,707
	Lake Benbrook (TRWD)	1,162	2,077	2,862	5,826	8,824	8,770
	Total	**4,085**	**4,957**	**5,699**	**7,860**	**7,860**	**7,860**
West Cedar Creek	**TRWD (limited by contract)**	**2,220**	**2,220**	**2,220**	**2,220**	**2,220**	**2,220**
Wise County WSD	**TRWD (limited by WTP Capacity)**	**1,850**	**1,850**	**1,850**	**1,850**	**1,850**	**1,850**

3.6 Water Availability by Water User Group (WUG)

As part of the regional water planning process, the TWDB requires development of information on currently available water supplies for each water user group (WUG) by river basin and county. (Water user groups are cities with populations greater than 500, water suppliers other than cities that supply an annual average of at least 0.25 million gallons per day (mgd), "county-other" municipal uses that cover municipal use outside of designated WUGs (by small suppliers and individuals), and countywide manufacturing, irrigation, mining, livestock, and steam electric uses.) The availability figures by water user group are limited by contracts and existing physical facilities, including transmission facilities, groundwater wells, and water treatment. The supplies available to each WUG are shown in Appendix J.

As the information on currently available water supply for WUGs was developed, several important points became apparent:

- Most water user groups in Region C will need additional water supplies over the next 50 years to meet growing demands.
- There are some significant water supplies that can be made available by the development of additional water transmission facilities. An example is the full development of Dallas Water Utilities' share of Lake Palestine in the Neches Basin.

3.7 Summary of Current Water Supplies in Region C

- Region C water suppliers are currently using nearly 70 percent of the reliable supply available from in-region reservoirs.
- The projected overall water supply available to Region C in 2070 from current sources is 2,270,143 acre-feet per year. (This figure does not consider supply limitations due to the capacities of current raw water transmission facilities and wells.) The sources of supply for Region C in 2070 include:
    - 1,177,262 acre-feet per year (52%) from in-region reservoirs
    - 146,096 acre-feet per year (6%) from groundwater
    - 28,665 acre-feet per year (less than 2%) from local supplies
    - 427,011 acre-feet per year (19%; up four percent from the 2011 Region C Plan) from reuse
    - 491,109 acre-feet per year (22%) from imports from other regions
- Considering supply limitations due to the capacities of current raw water transmission facilities and wells, the currently available supply for Region C water users in 2070 is over 1.63 million acre- feet per year, with 15,364 acre-feet per year for water users in other regions. The total available supply is 2,270,143 acre-feet per year, which is over 638,000 acre-feet per year more than the currently available supply. Most water user groups and wholesale water providers in Region C will have to make improvements to their facilities to meet projected needs.

- The supply currently available to Region C from existing sources in 2070 (1.63 million acre-feet per year) is significantly less than the projected 2070 water use, which is over 2.59 million acre-feet per year.
- The currently available supply for 2060 presented in this plan (1,648,866 acre-feet per year) is less than what was in the 2011 Region C Plan (1,793,842 acre-feet per year) mainly due to the use of safe yields by TRWD and DWU and the lower Chapman yield using the new critical period for the reservoir.
- Several major water suppliers will require additional raw water transmission facilities to make full use of their existing sources.
- Some sources of supply will probably not be utilized fully during the period covered by this plan, but these will generally be the smaller local supplies.

CHAPTER 3
LIST OF REFERENCES

(1) Texas Water Development Board, *Exhibit C First Amended General Guidelines for Regional Water Plan Development* (October 2012), Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2016/doc/current_docs/contract_docs/2012_exhC_1st_amended_gen_guidelines.pdf, January 28, 2013.

(2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

(3) Texas Water Development Board: *Groundwater Pumpage Estimates, Pumpage Detail, 2000 and Later*, Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/historical-pumpage.asp, September 2013.

(4) Texas Water Development Board: *Water Use Summary Estimates, County, Summary, 2000 and Later*, Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/, February 2, 2015.

4 Identification of Water Need

Texas Water Development Board (TWDB) guidelines require that reserves and needs for additional water supply be determined for each water user group in the region based on the comparison of current water supply and projected demand. The specific surpluses and needs shown should be treated with caution because their development requires certain assumptions:

- TWDB guidelines require that the comparison be based on currently connected supplies, without considering the future connection of already developed supplies [(1)].
- The division of existing supplies among users can be made in many ways. For example, the amount of groundwater available in a county on a sustainable basis was divided among users based on historical use and on well capacities. The actual future groundwater use may differ from these assumptions.

The resulting comparison shows the reserves and needs that will exist in Region C if no steps are taken to connect existing water supplies or develop additional water supplies. This comparison is specifically required by Texas Water Development Board planning guidelines [(1)]. Development of infrastructure to make existing supplies available to users and development of new supplies are treated as water management strategies, and they will be discussed in Chapter 5.

In the remainder of this section, projected water demands are compared to currently available water supplies, and projected water shortages and reserves are identified for Region C as a whole (Section 4.1), for wholesale water providers (Section 4.2), and for water user groups (Section 4.3). In addition, the projected shortages are summarized (Section 4.4), and finally, the projected shortages after the second-tier needs analysis are discussed (Section 4.5).

4.1 Regional Comparison of Supply and Demand

Table 4.1 and Figure 4.1 summarize the comparison of total currently connected water supply and total projected water demand in Region C, considering all water user groups. If only water user groups with projected shortages (and not reserves) are considered, there is a need for approximately 125,000 acre-feet per year of additional supply by 2020, growing to a need for 1.36 million acre-feet per year of additional supply by 2070, based on currently connected supplies.

Table 4.1
Comparison of Connected Supply with Projected Demand by Decade in Region C (Acre-Feet per Year)

Item	2020	2030	2040	2050	2060	2070
Connected Supply in Region C	1,684,444	1,663,069	1,658,616	1,659,618	1,648,866	1,631,341
Projected Demand	1,723,325	1,944,991	2,182,948	2,425,837	2,676,836	2,939,880
Total Regional Reserve or (Need)	(38,881)	(281,922)	(524,332)	(766,219)	(1,027,970)	(1,308,539)
Regional Reserve or (Need) Considering Only Water User Groups With Needs	(125,037)	(367,207)	(604,016)	(834,272)	(1,086,226)	(1,356,372)
Counties with Needs	16	16	16	16	16	16
User Groups with Needs	170	242	257	268	275	283

Figure 4.1
Comparison of Connected Supply with Projected Demand by Decade for Region C

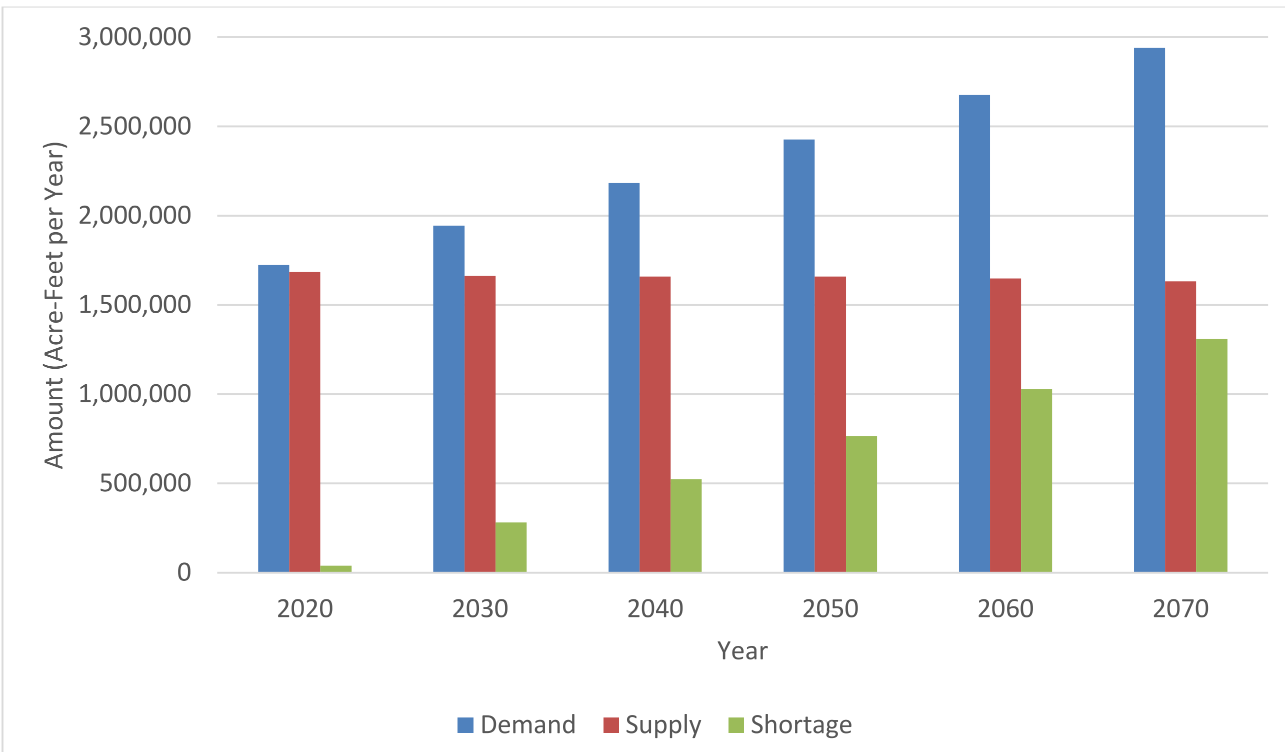


Figure 4.2
Projected Shortage by Use Type for Region C in 2070

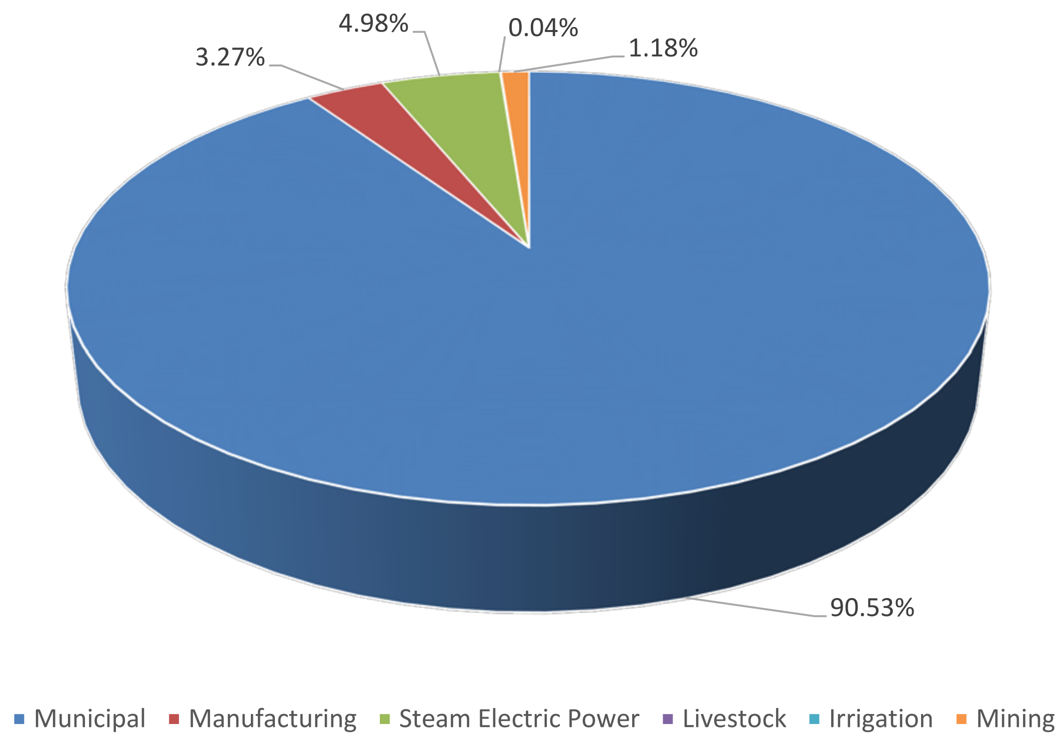


Figure 4.2 shows the projected distribution of shortages. Approximately ninety percent of the projected shortage in 2070 is for municipal users. It should be noted that most of the "shortages" shown for 2020 are fully met with expected conservation savings which is treated as a water management strategy rather than a currently available supply. This is discussed in more detail in Section 4.6 regarding the second-tier needs analysis.

Table 4.2 shows the comparison of supply and demands by county. In 2020, 16 out of the 16 counties show a net need for more water. On a regional basis, 283 water users in Region C are predicted to have a need for additional water by 2070. In general, the largest water needs are in Collin, Dallas, Denton and Tarrant Counties, with lesser but significant needs in other counties.

The comparison of supply and demand in Table 4.1 and Figure 4.1 focuses on currently connected supplies. These currently connected supplies differ from "existing supplies" in TWDB's online regional planning database (DB17) because DB17 does not recognize connected but unused supplies. For example, all of the groundwater in Region C is considered existing in DB17, but the connected supplies presented here do not consider unused groundwater an existing/connected supply. Region C also has a significant amount of unconnected supplies that could be made available to the region. An unconnected water supply is an existing and permitted supply that is not currently available due to infrastructure limitations. Table 4.3 and Figure 4.3 show the comparison of total supply with demand for Region C, including connected and unconnected supply and surface water imports from other regions. By 2050, the projected demand for Region C exceeds total connected and unconnected supply.

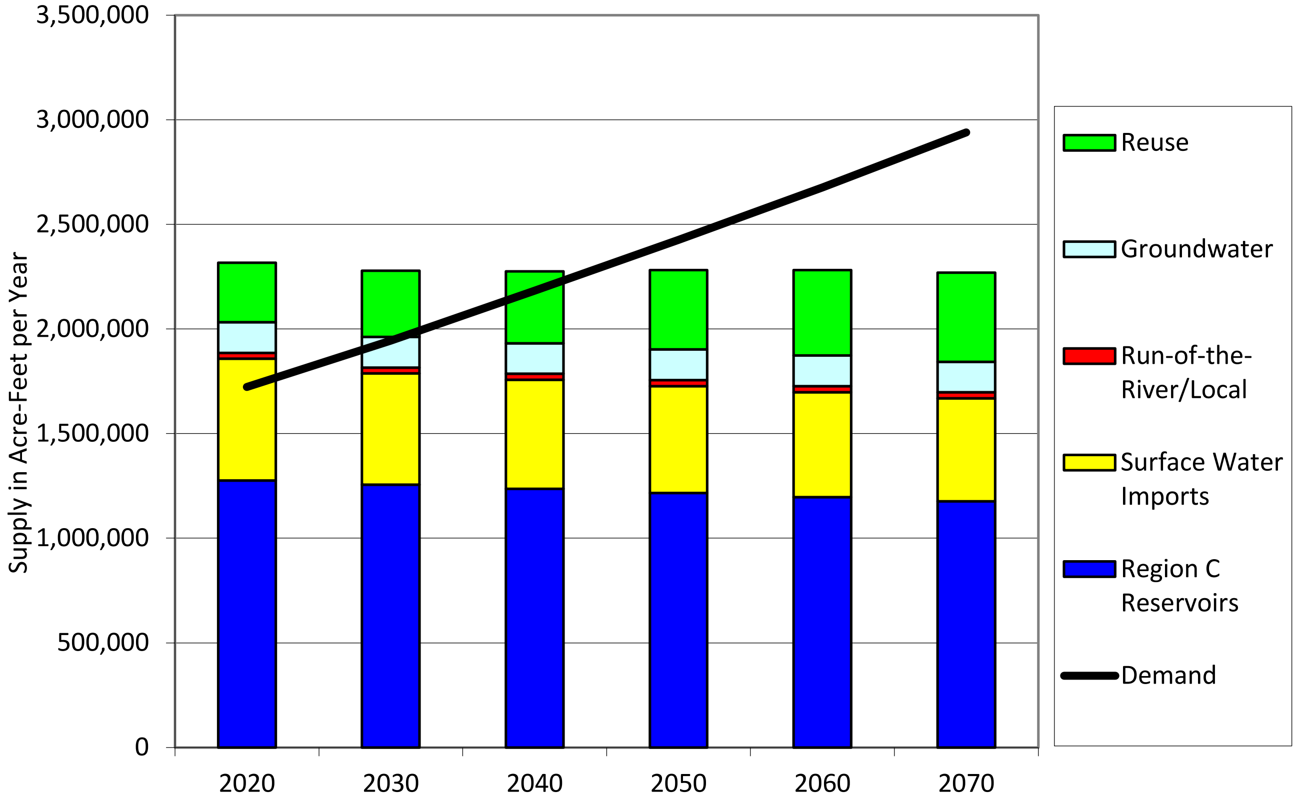
Table 4.2
Reserve or (Need) by County for Region C (Acre-Feet per Year)

County	2020	2030	2040	2050	2060	2070
Collin	(18,865)	(65,722)	(105,470)	(145,168)	(177,270)	(207,655)
Cooke	(849)	(288)	(300)	(461)	(1,058)	(5,017)
Dallas	(42,674)	(101,656)	(159,703)	(206,626)	(248,412)	(280,615)
Denton	(12,241)	(47,075)	(86,617)	(128,970)	(174,830)	(216,283)
Ellis	(1,611)	(5,680)	(14,495)	(24,579)	(43,984)	(73,554)
Fannin	(56)	(5,123)	(6,839)	(9,423)	(13,856)	(18,776)
Freestone	(4,544)	(4,320)	(4,431)	(7,883)	(15,060)	(24,863)
Grayson	(86)	(8,106)	(10,067)	(13,483)	(21,829)	(36,244)
Henderson	(1,846)	(5,208)	(6,633)	(8,146)	(12,249)	(18,249)
Jack	(981)	(1,430)	(1,734)	(2,120)	(2,496)	(2,938)
Kaufman	(1,860)	(5,699)	(9,813)	(15,757)	(24,954)	(38,113)
Navarro	(8,000)	(17,038)	(17,838)	(19,144)	(21,055)	(23,704)
Parker	(3,349)	(6,752)	(11,025)	(18,031)	(32,667)	(51,749)
Rockwall	(1,645)	(6,407)	(9,200)	(12,319)	(16,717)	(22,345)
Tarrant	(24,130)	(82,442)	(151,925)	(207,390)	(257,690)	(305,928)
Wise	(2,300)	(4,261)	(7,926)	(14,772)	(22,099)	(30,339)
Total	**(125,037)**	**(367,207)**	**(604,016)**	**(834,272)**	**(1,086,226)**	**(1,356,372)**

Table 4.3
Comparison of Total Connected and Unconnected Supply with Region C Demand (Acre-Feet per Year)

Item	2020	2030	2040	2050	2060	2070
Total Connected and Unconnected Supply	2,316,273	2,279,349	2,275,427	2,282,147	2,281,830	2,270,143
Demand	1,723,325	1,944,991	2,182,948	2,425,837	2,676,836	2,939,880
Reserve/(Need)	592,948	334,358	92,479	(143,690)	(395,006)	(669,737)

Figure 4.3
Comparison of Connected and Unconnected Supply and Demand for Region C



4.2 Comparison of Connected Supply and Projected Demand by Wholesale Water Provider

Under the planning rules, a wholesale water provider (WWP) is defined as an entity that sold or had contracts to sell more than 1,000 acre-feet of water on a wholesale basis in recent years or that is projected to sell more than 1,000 acre-feet per year on a wholesale basis during the planning period [(1)]. The Region C Water Planning Group has designated 41 wholesale water providers for Region C. Table 4.4 summarizes the comparison of supply and demand and shows the reserves or needs for additional supply for each wholesale water provider. As a group, the wholesale water providers are projected to have a need for additional supply in each decade of the planning period. Steps to meet these projected needs will be discussed in Section 5C.

Two wholesale water providers do not have a projected shortage in Region C within the planning period: Dallas County Park Cities Municipal Utility District and Sabine River Authority. The Sulphur River Basin Authority does not currently provide water supply, but is expected to do so in the future. The need listed for SRBA is equivalent to the anticipated future contract amounts. Five wholesale water providers (Dallas Water Utilities, Tarrant Regional Water District, North Texas Municipal Water District, Trinity River Authority and Upper Trinity Regional Water District) provide water to meet approximately 90 percent of the total demand in Region C.

4.3 Comparison of Connected Supply and Projected Demand by Water User Group

Projected supplies, demands, reserves, and shortages are summarized for each water user group in Appendix C. As shown on Table 4.1, there are 283 water user groups with projected water shortages by 2070.

Chapter 5D of this report discusses the selection of water management strategies to address the requirements for additional supply. Many water user groups in Region C are served by wholesale water providers, and the needs of these water user groups will be addressed by obtaining additional supplies from the wholesale water providers. Other water user groups will require the development of individual water management strategies to address their needs.

Table 4.4
Reserve or (Need) by Wholesale Water Provider Using Only Connected Supplies (Acre-Feet per Year)

Wholesale Water Provider	Projected Needs for Current and Future Customers					
	2020	2030	2040	2050	2060	2070
Argyle Water Supply Corporation	0	(373)	(1,044)	(1,398)	(1,535)	(1,714)
Arlington	0	(6,792)	(15,031)	(22,414)	(28,829)	(34,470)
Athens Municipal Water Authority	1,283	921	599	170	(2,597)	(5,987)
Corsicana	1,989	(4,355)	(5,343)	(6,885)	(8,986)	(11,662)
Cross Timbers Water Supply Corporation	0	(176)	(347)	(492)	(562)	(679)
Dallas County Park Cities Municipal Utility District	5,222	5,094	5,067	4,980	4,841	4,692
Dallas Water Utilities	(20,117)	(71,412)	(137,609)	(198,449)	(327,509)	(296,881)
Denison	0	(736)	(1,421)	(2,182)	(3,711)	(6,241)
Denton	(3,204)	(11,891)	(21,639)	(34,217)	(56,291)	(74,217)
East Cedar Creek Freshwater Supply District	0	(169)	(414)	(687)	(1,132)	(1,867)
Ennis	(156)	(510)	(1,313)	(3,218)	(8,745)	(19,014)
Forney	(564)	(1,883)	(2,843)	(3,965)	(6,013)	(9,815)
Fort Worth	(12,227)	(65,035)	(127,398)	(172,425)	(214,360)	(257,766)
Gainesville	750	1,053	1,087	679	(774)	(5,022)
Garland	(3,304)	(9,890)	(12,404)	(14,006)	(15,814)	(17,761)
Grand Prairie	(5,704)	(9,118)	(13,521)	(15,903)	(18,263)	(19,715)
Greater Texoma Utility Authority	(329)	(18,197)	(21,589)	(27,460)	(44,384)	(67,017)
Lake Cities Municipal Utility Authority	0	(409)	(868)	(1,261)	(1,385)	(1,529)

Wholesale Water Provider	Projected Needs for Current and Future Customers					
	2020	2030	2040	2050	2060	2070
Mansfield	(11,730)	(15,141)	(19,946)	(28,699)	(34,482)	(40,709)
Midlothian	(1,550)	(3,263)	(5,646)	(8,017)	(10,354)	(12,491)
Mustang Special Utility District	0	(2,245)	(5,022)	(7,862)	(9,924)	(11,941)
North Richland Hills	(5,335)	(6,058)	(6,294)	(6,571)	(6,878)	(7,353)
North Texas Municipal Water District	(30,540)	(103,975)	(152,935)	(201,898)	(256,574)	(316,373)
Princeton	(102)	(375)	(638)	(1,477)	(2,484)	(3,772)
Rockett Special Utility District	(3,370)	(5,796)	(8,560)	(10,961)	(15,010)	(22,435)
Rockwall	(1,156)	(4,882)	(6,916)	(8,782)	(11,452)	(14,651)
Sabine River Authority [a]	642,875	624,319	346,838	142,727	86,754	9,196
Seagoville	(1,138)	(1,556)	(2,094)	(2,759)	(4,206)	(5,922)
Sherman	(187)	(1,013)	(2,965)	(5,249)	(10,660)	(20,153)
Sulphur River Basin Authority [c]	0	0	0	72,670	127,120	489,800
Tarrant Regional Water District	(33,311)	(102,377)	(176,044)	(259,326)	(349,689)	(460,608)
Terrell	(421)	(2,039)	(4,052)	(6,967)	(10,426)	(14,239)
Trinity River Authority	(76,476)	(71,427)	(76,617)	(83,666)	(92,676)	(118,810)
Upper Neches River Municipal Water Authority [a, b]	(4,831)	(6,849)	(8,869)	(10,892)	(12,919)	(14,940)
Upper Trinity Regional Water District	8,731	(7,936)	(33,168)	(57,700)	(72,862)	(94,203)
Walnut Creek Special Utility District	0	(288)	(779)	(1,585)	(3,472)	(5,930)
Waxahachie	2,367	1,025	(3,381)	(5,738)	(9,124)	(14,017)
Weatherford	(2,255)	(2,632)	(3,310)	(7,584)	(15,969)	(26,618)
West Cedar Creek Municipal Utility District	(322)	(639)	(989)	(1,461)	(2,714)	(4,432)
Wise County Water Supply District	(1,708)	(2,471)	(3,334)	(6,048)	(8,380)	(10,703)

[a] Obtained from the East Texas Regional Water Planning Area Plan
[b] Does not include potential future customers
[c] Does not currently supply water. Need is equivalent to anticipated contract amounts from Sulphur Basin Supplies strategy.

4.4 Summary of Projected Water Shortages

- If no new supplies are developed, the total of projected shortages in Region C is approximately 39,000 acre-feet per year by 2020, growing to over 1.3 million acre-feet per year by 2070.
- Many of the shortages in 2020 are fully addressed by water conservation measures.
- There are substantial unconnected supplies in Region C that could be made available by completing water transmission facilities.
- All of the Region C counties have net needs for more water beginning in 2020.
- There are 170 water user groups are projected to need more supply in 2020, growing to 283 water user groups by 2070.
- Many Region C water suppliers depend on the region's wholesale water providers for all or part of their supplies. All but two of the wholesale water providers will need to develop additional supplies by 2070.

4.5 Second-Tier Needs Analysis

A new requirement for this round of planning is the performance of a second-tier needs analysis for all WUGs and WWPs for which conservation and direct reuse are recommended WMSs. The second-tier needs analysis determines water needs that would remain if recommended conservation and direct reuse strategies were fully implemented. TWDB has provided a second-tier water needs analysis report from DB17. This report is included in Appendix U. Table 4.5 summarizes the second-tier needs by WUG category.

Table 4.5
Second-Tier Water Needs by WUG Category (Acre-Feet per Year)

WUG Category	2020	2030	2040	2050	2060	2070
Municipal	58,688	201,823	403,588	603,410	822,948	1,057,690
Manufacturing	2,649	11,184	19,228	26,446	33,893	41,392
Mining	6,105	5,689	6,931	8,327	9,720	11,854
Steam Electric Power	9,006	29,380	34,264	41,737	50,538	60,489
Livestock	0	0	0	0	0	0
Irrigation	393	406	418	429	437	440
Total	**76,841**	**248,482**	**464,429**	**680,349**	**917,536**	**1,171,865**

CHAPTER 4

LIST OF REFERENCES

(1) Texas Water Development Board, *Exhibit C First Amended General Guidelines for Regional Water Plan Development (October 2012) Fourth Cycle of Regional Planning, Austin,* [Online] URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2016/doc/current_docs/contract_docs/2012_exhC_1st_amended_gen_guidelines.pdf, October 2012.

5A Methodology for Evaluation and Selection of Water Management Strategies

This section describes the process to determine potentially feasible strategies for Region C and the methods used in evaluation of potentially feasible strategies and the selection of recommended strategies. The steps in the evaluation and selection of water management strategies for Region C include the following:

- Review of previous plans for water supply in Region C, including locally developed plans and the 2012 State Water Plan [(1)]
- Consideration of the types of water management strategies required by Senate Bill One regional planning guidelines [(2)]
- Development of evaluation criteria for management strategies
- Selection for evaluation of potentially feasible water management strategies that could meet needs in Region C
- Environmental evaluation of individual strategies
- Development of cost information for individual strategies
- Input from wholesale water providers and water user groups
- Selection of recommended strategies for Region C

As part of Task 4B (Potentially Feasible Water Management Strategies), Region C produced a memorandum to TWDB dated November 10, 2011 with Subject "Methodology for Evaluating Water Management Strategies for the 2016 Region C Water Plan." The RCWPG approved the methodology laid out in this memo at the October 25, 2011 RCWPG public meeting (Agenda Item III.B.). Region C consultants later presented the RCWPG with a full list of Potentially Feasible Water Management Strategies at the January 26, 2015 RCWPG public meeting (Agenda Item IV.F.). RCPWG approved the potentially feasible and recommended WMSs as part of the Initially Prepared Plan at the April 20, 2015 RCWPG public meeting (Agenda Item IV.A.).

5A.1 Types of Water Management Strategies

Regional Planning guidelines require that certain types of water management strategies be considered as means of developing additional water supplies. The types of strategies that must be considered include the following [2]:

- Water conservation and drought response planning
- Reuse of wastewater
- Expanded use or acquisition of existing supplies, including system optimization and conjunctive use
- Reallocation of reservoir storage to new uses
- Voluntary redistribution of water resources
- Voluntary subordination of water rights
- Enhancement of yields of existing sources
- Control of naturally occurring chlorides
- Brush control, precipitation enhancement, and desalination
- Water right cancellation
- Aquifer storage and recovery
- New supply development
- Interbasin transfers
- Other measures.

The Region C Water Planning Group reviewed each of these types of water management strategies and determined whether there were potentially feasible strategies to develop water supply in Region C within each type. Water conservation and drought response planning and reuse strategies are discussed in Section 5E. Drought response planning is discussed in Chapter 7. Other types of management strategies are discussed below, and a more detailed listing of potentially feasible water management strategies for Region C is included in Appendix O. The impacts of potential water management strategies are considered in Appendix P. The methodology used for quantitatively assessing impacts are discussed in Appendix P.

5A.1.1 Expanded Use of Existing Supplies

Reservoir System Operation

System operation is the coordinated use of multiple sources of supply, usually surface water reservoirs. System operation is widely used throughout Region C, and can be implemented for many purposes, including gaining yield, reducing pumping costs, or maintaining acceptable water quality. Most of the systems in Region C are operated primarily to reduce pumping costs. For the purpose of the Region C planning process, only system operation that results in increased yield will be considered as potentially feasible water management strategies. The following system operations were adopted as potentially feasible strategies to gain additional supplies for Region C:

- Dallas Water Utilities reservoirs
- Tarrant Regional Water District reservoirs
- System operation of Wright Patman Lake and other sources to gain additional yield.

Summary of Decision: System operation is widely used in Region C, primarily to reduce pumping costs. Potentially feasible system operation strategies to provide additional yield should be investigated.

Connecting Existing Supplies

The connection of existing supplies that are not yet being fully utilized was a major element of the 2011 Region C Water Plan [(3)]. There are several sources of water supply that have long been committed for use in Region C and could be connected to provide additional water supply. Region C water suppliers could also connect to currently uncommitted supplies in other regions, but these supplies are not necessarily available for use in Region C.

Table 5A.1 lists potentially feasible water management strategies for Region C based on the connection of existing sources that would supply over 25,000 acre-feet per year. The volumes of supply listed in this table represent the maximum amount available from the source, which in some cases is greater than the volume that is being recommended in this plan. In addition to the strategies listed in Table 5A.1, smaller potentially feasible strategies to connect existing supplies are listed in Appendix O. There are also several general categories of strategies to connect existing supplies that are considered to be potentially feasible in Region C:

- Connections to other water user groups or wholesale water providers
- Expansion and renovation of existing connections and transmission systems
- New, renewed, and increased contracts for water
- Water treatment plant expansions.

The development (or continued development) of regional water systems was also an important part of the 2011 Region C Water Plan [(3)]. The following regional systems were in the 2011 Plan and are potentially feasible strategies for this plan:

- North Texas Municipal Water District
- Upper Trinity Regional Water District

- Trinity River Authority Tarrant County Water Supply Project
- Trinity River Authority Ellis County Project
- Cooke County
- Grayson County
- Fannin County
- Walnut Creek SUD.

The expected time to implement strategies connecting to existing supplies can vary greatly depending on the strategy. Strategies such as the construction of a water treatment plant, new/renewed contracts, or renovating an existing transmission system are assumed to take three years or less. Strategies connecting to an existing surface water supply in a river basin different from the basin of use are anticipated to take 5 to 10 years for the permitting process because of the need for an interbasin transfer permit. Construction of a transmission system for projects moving large amounts of water over long distances are expected to take 5 to 8 years.

Summary of Decision: Include connection of existing supplies as a major component of the Region C plan. Evaluate specific potentially feasible strategies for connection of existing supplies.

Table 5A.1
Major Potentially Feasible Water Management Strategies for Connecting Existing Supplies

Strategy	Potential Sponsor(s) [a]	Maximum Supply [b] Available to Region C from Strategy in Acre-Feet per Year	Recommended Included in 2011 Plan?
Toledo Bend Reservoir	SRA, NTMWD, TRWD, DWU, and UTRWD	600,000 (part of Texas' share)	Yes
Gulf of Mexico with Desalination	DWU, NTMWD, and TRWD	Unlimited [c]	No
Wright Patman pool raise (to 232.5, as part of Sulphur Basin Supplies)	DWU, NTMWD, TRWD, UTRWD, and Irving	127,120 [d]	No
Oklahoma Water	NTMWD, TRWD, UTRWD, and Irving,	165,000 or more	Yes
Lake Texoma – Unauthorized [e]	NTMWD, DWU, and UTRWD	220,000	No
NTWMD Lake Texoma - Authorized	NTMWD	113,000	Yes
Lake Palestine	DWU	110,670	Yes
Wright Patman Lake – Texarkana	DWU, NTMWD, TRWD, UTRWD, or Irving	100,000	No

Strategy	Potential Sponsor(s) [a]	Maximum Supply [b] Available to Region C from Strategy in Acre-Feet per Year	Recommended Included in 2011 Plan?
Carrizo-Wilcox Groundwater (Wood, Smith, Upshur Counties)	DWU	102,930	No
Carrizo-Wilcox Groundwater (Freestone & Anderson Counties)	NTMWD	42,000	No
Cypress River Basin Supplies (Lake O' the Pines)	DWU, NTMWD, or TRWD	unknown [f]	No
GTUA Lake Texoma Already Authorized	GTUA	56,500	Yes
Ellis County Project	TRA / TRWD	74,610	Yes
Expanded NTMWD/GTUA Collin Grayson Municipal Alliance	Multiple	30,000	Yes
Reuse	Multiple	355,118	Yes

Notes:
a. Recommended and alternative strategies for wholesale water providers are discussed in Section 5C.
b. Volumes of supply listed in this table represent the maximum amount available from the source, which in some cases is greater than the volume that is being recommended in this plan.
c. This strategy was evaluated for the transmission of 200,000 acre-feet per year of treated water to the Metroplex.
d. This Wright Patman water supply is not currently permitted or authorized, but could be made available through the reallocation of flood storage.
e. This Texoma water supply is not currently permitted or authorized, but could be made available through the reallocation of hydropower storage.
f. The amount of supply available from Lake O' the Pines is unclear. In past regional plans, supply was assumed to be available, but based on the 2016 Initially Prepared Region D Plan, it appears the region intends to fully utilize this source for future Region D demands. For purposes of this plan, cost estimates for this potential strategy were based on a volume of 87,900 acre-feet per year.

Conjunctive Use of Groundwater and Surface Water

In Region C, only 6 percent of the water used comes from groundwater. Groundwater is sometimes used to meet peak demands in systems that have both groundwater and surface water supplies. This does not, however, increase total supply on an annual basis. Therefore, conjunctive use should not be considered as a potentially feasible water management strategy to provide additional supplies for Region C.

Summary of Decision: Do not include the conjunctive use of groundwater and surface water as a source of additional supplies for Region C. Conjunctive use to meet peak needs is appropriate and should continue.

5A.1.2 Reallocation of Reservoir Storage

There are two types of reallocation of existing reservoir storage. Reallocation among various water supply uses (municipal, industrial, irrigation, etc.) is a relatively simple matter. It is considered to be a minor water right amendment by Texas Commission on Environmental Quality (TCEQ). This type of reallocation should be allowed at the discretion of the owner of the water right and should be considered to be consistent with the Region C plan.

The more complex type of reallocation is to transfer water from other uses such as hydropower generation or flood control to water supply. There are three reservoirs that have the potential for this type of storage reallocation and might provide supplies for Region C:

- Wright Patman Lake in the Sulphur River Basin in Region D has storage allocated to flood control that could be reallocated for municipal use. This would require environmental studies by the Corps of Engineers and Congressional approval.
- In Lake Texoma in the Red River Basin, Congress has already approved the reallocation of 150,000 acre-feet of storage from hydropower to municipal use in Texas and 150,000 acre-feet of storage from hydropower to municipal use in Oklahoma. Actual reallocation requires environmental studies which were completed in May 2006 [(4)]. Storage has been reallocated for municipal use in Texas, and the North Texas Municipal Water District and Greater Texoma Utility Authority have contracted for the storage and obtained Texas water rights for the resulting supplies. The reallocation of water for municipal use in Oklahoma has not yet occurred. Additional reallocation from hydropower storage to conservation storage is possible in Lake Texoma, and this would require additional Congressional approval.
- The reallocation of flood storage to municipal storage in Bardwell Lake in Ellis County has also been considered.

Most other Region C reservoirs with flood control or hydropower storage already have sufficient conservation storage to develop their potential supplies. Therefore, the reallocation of storage in other reservoirs is not likely to provide significant additional supplies for the region.

The implementation of this type of strategy is expected to take between 10 and 15 years depending upon study results and requirement for Congressional action.

Summary of Decision: Permit transfers among types of water use at the discretion of the water right holder. Evaluate reallocation to municipal use for Lake Texoma, Wright Patman Lake, and Bardwell Lake.

5A.1.3 Voluntary Redistribution of Water Resources

In many cases, the connection of existing sources and the development of new sources require the voluntary redistribution of water resources by sale from the owner of the supply to the proposed user.

(This would be true unless the proposed user is also the owner of the supply.) Emergency transfers of non-municipal use surface water are not considered a viable strategy for Region C. The water management strategies involving the voluntary redistribution of water resources are discussed under other categories and the impacts from voluntary redistributions of water supplies are considered in Appendix P.

Summary of Decision: Evaluate potentially feasible strategies involving the voluntary redistribution of water resources under other categories.

5A.1.4 Voluntary Subordination of Water Rights

Voluntary subordination of water rights is most useful where senior water rights limit reservoir yields under the prior appropriations doctrine. Very little additional yield is available for existing reservoirs in Region C by voluntary subordination. This strategy is appropriate for new water supply sources that would have junior water rights. In Region C, subordination of water rights is necessary to obtain the permitted amount for Muenster Lake in Cooke County.

Summary of Decision: Include voluntary subordination of water rights as a source of water supply for Muenster Lake.

5A.1.5 Enhancement of Yields of Existing Sources

Examples of ways to enhance the yield of existing sources might include the following:

- Artificial recharge of aquifers
- System operation of reservoirs
- Conjunctive use of surface water and groundwater

System operation of reservoirs and conjunctive use are discussed separately above. Artificial recharge of aquifers has not been implemented or studied in depth in Region C. If artificial recharge were to be implemented, it would likely be as part of an aquifer storage and recovery (ASR) program, which is discussed separately below.

Summary of Decision: Do not include enhancement of yields of existing sources as a source of water supply for Region C except as discussed under other categories.

5A.1.6 Control of Naturally Occurring Chlorides

The Brazos and Red River Basins have chloride concentrations in excess of desirable levels for municipal use. Much of the chloride in these basins is naturally occurring. Chloride control has been studied in the Brazos and Red River Basins and partially implemented in the Red River Basin. Current plans call for additional chloride control in the Lake Kemp watershed in Region B. If that project is successful, additional chloride control in the Lake Texoma watershed could be possible. However, it does not appear likely that chloride control will have a significant impact on chloride levels in Lake Texoma during the current planning horizon. Chloride control projects should continue to be monitored. The Texas Commission on Environmental Quality and the Texas Railroad Commission should continue efforts to control chloride resulting from man-made conditions.

Summary of Decision: Monitor chloride control projects. Do not include control of naturally occurring chlorides as a source of water supply for Region C.

5A.1.7 Brush Control

Brush control is the process of removing non-native brush from the banks along rivers and streams and upland areas in order to reduce water consumption by vegetation and increase stream flows and groundwater availability. Studies and pilot projects on brush control in West Texas show promising results. The first large-scale projects are currently underway. Undertaking and maintaining brush control is expensive and requires landowner participation.

The Texas State Soil and Water Conservation Board published the updated State Brush Control Plan in 2007 (5). This plan identifies areas that could potentially benefit from brush control programs. Two reservoirs in Region C, Lake Jacksboro and Lake Weatherford, were listed in the State Brush Control Plan as potential watersheds where brush control could enhance supplies. No formal studies have been conducted for either watershed. Given that there is no quantifiable evidence that brush control would increase water supply in either reservoir, brush control is not recommended as a potentially feasible water management strategy for any specific water user group (WUG) in Region C. However, brush control may be a management strategy for localized areas within the region, especially as a means to help meet localized livestock water supply needs.

Summary of Decision: Allow for studies and localized pilot projects to further investigate brush control. Do not consider brush control as a potentially feasible strategy for the development of additional water supplies.

5A.1.8 Precipitation Enhancement

Precipitation enhancement involves seeding clouds with silver iodide to promote rainfall. Such programs are generally located within areas where the rainfall is lower than in Region C. Given that Region C has adequate rainfall, and that there are no studies showing what impact precipitation enhancement would have on streamflow and reservoirs in Region C, precipitation enhancement is not recommended as a potentially feasible water management strategy for Region C. However, there may be localized areas in Region C who might benefit from such a management strategy.

Summary of Decision: Do not include precipitation enhancement as a potentially feasible strategy for the development of additional water supplies. Allow for studies and localized pilot projects to further investigate precipitation enhancement.

5A.1.9 Desalination

The salinity of water in Lake Texoma and the Red River is too high for municipal use, and the water must be desalinated or blended with higher quality water in order to meet drinking water standards. The cost of desalination has decreased in recent years, and the process is being used more frequently. Desalination is a potentially feasible strategy to use supplies from the following sources:

- Lake Texoma and the Red River
- Brackish groundwater
- Water from the Brazos River
- Water from the Gulf of Mexico
- Local projects from other sources, if pursued by water suppliers.

Summary of Decision: Include desalination as a potentially feasible management strategy in order to utilize supplies from the sources listed above.

5A.1.10 Water Rights Cancellation

The Texas Commission on Environmental Quality has the power to cancel water rights after ten years of non-use, but this involuntary cancellation authority has seldom been used. The Water Availability Models showed that very little additional supply would be gained from water right cancellation in Region C [(3)].

Therefore, water rights cancellation is not recommended as a potentially feasible water management strategy for Region C.

Summary of Decision: Do not consider water rights cancellation as a potentially feasible strategy for the development of additional water supplies.

5A.1.11 Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) involves storing water in aquifers and retrieving this water when needed. The water to be stored can be introduced through enhanced recharge or more commonly injected through a well into the aquifer. If an injection well is used, Texas law requires that the water be treated to drinking water standards prior to injection. Source water for ASR can include excess surface water, treated wastewater, or groundwater from another aquifer. While some ASR projects are for the purpose of enhancing water supply, other ASR projects are for the purpose of protection of current groundwater by preventing saltwater intrusion, forming a barrier between saline and freshwater aquifers.

The benefits of ASR include:

- Protection of current groundwater supply from saltwater intrusion,
- Storage of large volumes of water at lower costs than traditional surface storage,
- Reduction of evaporation losses,
- Minimization of environmental impacts associated with other new water sources such as new reservoirs, and
- Reduction of storage loss due to sedimentation.

While the concept of ASR is gaining popularity, it is important to recognize that there are numerous factors to be considered when determining whether ASR is a feasible strategy.

- ASR requires suitable geological conditions for implementation. Since geologic conditions vary by location, specific studies must be performed to determine what specific locations would be suitable for ASR.
- Water must be treated to drinking water standards prior to injection and then treated again to drinking water standards after it is retrieved. For surface water or wastewater sources, this means full scale treatment through a conventional water treatment plant, and for groundwater source water this generally means only chlorination.
- If the source water is surface water not already associated with a water right, then a Texas water right permit needs to be obtained. Issuance of this water right by TCEQ requires that use of this water does not interfere with existing permitted water rights, downstream water right holders, or environmental flow needs.

There are only three existing ASR Projects in Texas and they are discussed below.

- The City of El Paso's ASR system injects about 10 MGD of treated wastewater into local aquifers. The primary purpose of this project is to protect El Paso's fresh groundwater supplies, forming a physical barrier of injected water between saline and fresh groundwater supplies.
- San Antonio Water System's (SAWS) ASR program entails pumping water from the Edwards Aquifer when excess water is available under their existing permits, and storing it in the Carrizo Aquifer. The Edwards Aquifer Authority (EAA) regulates pumping from the Edwards Aquifer based on groundwater permits, aquifer levels and spring flow. This ASR program allows SAWS to store Edwards Aquifer water during wet times or low demand seasons, and to recover that water during droughts, peak usage, or when demand on the Edwards Aquifer is high. The project recovered large volumes of stored Edwards Aquifer water to San Antonio during the record-breaking drought between 2011 and 2014.
- The City of Kerrville is the only Texas facility that utilizes the traditional ASR method of taking excess surface water (from the Guadalupe River) and injecting into an aquifer to increase total volume of water supply. Kerrville's water rights from the Guadalupe River for use in the ASR project total 5,922 acre-feet per year.

While several ongoing feasibility studies are being performed within Region C, those studies are not advanced enough to determine the suitability of ASR as a source of supply for Region C at this time. Studies of ASR should continue, and pilot projects should be implemented if the strategy appears to be promising.

Summary of Decision: Studies of ASR should continue, and pilot projects should be implemented if the strategy appears promising. ASR projects determined to be viable should be added to future Regional Water Plans.

5A.1.12 Development of New Water Supplies

Surface Water Supplies

Over the years, many new reservoirs have been considered as sources of water supply for Region C. New reservoirs represent a large source of potential supply for Region C, but environmental impacts of reservoir development are a concern. Potential impacts of reservoir development include:

- Inundation of wetlands and other wildlife habitat, including bottomland hardwoods
- Changes to streamflows and streamflow patterns downstream
- Impacts on inflows to bays and estuaries
- Impacts on threatened and endangered species.

To develop a new reservoir, both a state water right permit and a federal Section 404 permit are required. The permitting process often takes 10 to 20 years, depending upon the project. Design and construction could take up to an additional 10 years. Following the completion of construction, sufficient time is needed to fill the reservoir. Because of the large amount of time needed to implement new reservoir strategies, long-term planning for these types of strategies is essential for implementation by the time the supply is needed.

In the 2011 Region C Water Plan, the following reservoirs were selected for detailed analysis after a preliminary screening:

- Upper Bois d'Arc Creek Lake
- Lower Bois d'Arc Creek Reservoir
- Lake Tehuacana
- Lake Ralph Hall
- George Parkhouse Lake (North)
- George Parkhouse Lake (South)
- Marvin Nichols Reservoir
- Fastrill Reservoir (later replaced with another strategy)
- Marvin Nichols Lake (1A).

In recent years, there have been several developments in planning for new surface water supply sources for Region C:

- The Upper Trinity Regional Water District has conducted additional studies of Lake Ralph Hall and has received a water right permit from the Texas Commission on Environmental Quality and filed application for a Section 404 permit from the U.S. Corps of Engineers.
- North Texas Municipal Water District is considering supplies from Lower Bois d'Arc Creek Reservoir and has received a water right permit from the Texas Commission on Environmental Quality and is currently seeking a Section 404 permit from the U.S. Corps of Engineers.
- Dallas is considering supplies from Lake Columbia.
- Tarrant Regional Water District is considering supplies from Lake Tehuacana.

Table 5A.2 shows the new reservoirs adopted as potentially feasible sources of additional water supply for Region C by the Region C Water Planning Group.

The Region C Water Planning Group also adopted the additional use of local surface water supplies as potentially feasible if needed and practical.

Summary of Decision: Evaluate Marvin Nichols Reservoir, Lower Bois d'Arc Creek Reservoir, Lake Ralph Hall, George Parkhouse Lake (North and South), Lake Columbia, and Lake Tehuacana as potentially feasible strategies.

Table 5A.2
Potentially Feasible Strategies for New Reservoirs

Strategy	Potential Region C Sponsor(s)	Maximum Supply Available to Region C from Strategy in Acre-Feet per Year	Recommended in 2011 Plan?
Marvin Nichols at elevation 313.5 (as part of Sulphur Basin Supplies)	DWU, NTMWD, TRWD, UTRWD, and Irving	375,240	No (recommended as part of other strategy)
Marvin Nichols Reservoir (elevation 328 msl)	DWU, NTMWD, TRWD, UTRWD, and Irving	489,000	Yes
Lower Bois d'Arc Creek Reservoir	NTMWD	120,200	Yes
George Parkhouse Lake (North)	DWU, NTMWD, UTRWD, or Irving	118,960	No (alternative)
George Parkhouse Lake (South)	DWU, NTMWD, UTRWD, or Irving	108,480	No (alternative)
Tehuacana Reservoir	TRWD	41,600	No (alternative)
Lake Columbia	DWU	56,050	No (alternative)
Lake Ralph Hall	UTRWD	34,050	Yes

<u>Groundwater Supplies</u>

New groundwater supplies within Region C are limited, since the majority of the available supplies are already developed. The Region C Water Planning Group identified a number of relatively small additional groundwater supplies as potentially feasible strategies, and these are listed in Appendix O. The planning group also authorized development of new wells as needed and as groundwater is available as a potentially feasible strategy.

Two major strategies for the importation of groundwater were also identified as potentially feasible:

- Dallas has an alternative strategy of importing up to 27 MGD (30,267 acre-feet pear year) of Carrizo-Wilcox groundwater from Wood, Upshur, and Smith Counties
- NTWMD has an alternative strategy of importing up to 42,000 acre-feet per year of Carrizo-Wilcox groundwater from Freestone and Anderson Counties in cooperation with Forestar.

Summary of Decision: Evaluate the importation of groundwater of the options described above. Evaluate specific potentially feasible groundwater supplies within Region C.

5A.1.13 Interbasin Transfers

Table 5A.3 shows the potentially feasible strategies for Region C that would require interbasin transfer permits. (Under Texas law, interbasin transfer permits are required to transfer surface water from one river basin to another. They are not required for the transfer of groundwater.) Several of the strategies listed in Table 5A.3 have already been granted interbasin transfer permits, including Dallas' Lake Tawakoni pipeline and connection to Lake Palestine and NTMWD's supply from Lake Texoma. Existing sources with the potential to provide supply to Region C that would require interbasin transfer permits include the Brazos River Authority system, Wright Patman Lake, Toledo Bend Reservoir, additional Lake Palestine water, Cypress River Basin water (Lake O' the Pines), Oklahoma reservoirs, and the Gulf of Mexico. Potential new surface water supplies that would need interbasin transfer permits include Marvin Nichols Reservoir, George Parkhouse North and South Lakes, Lower Bois d'Arc Creek Reservoir, Lake Columbia, Neches Run-of-River, and Lake Ralph Hall. Overall water supplies in the Trinity and Brazos River Basins are mostly or completely allocated, while the Red, Sulphur, Cypress Creek, Sabine, and Neches Basins may have supplies in excess of their projected demands. Detailed studies of water needs in the receiving and the source basins will be required as part of the permitting process for new interbasin transfers. Development of adequate supplies for Region C and the other growing areas of Texas will require interbasin transfers.

Summary of Decision: Include interbasin transfers as part of the management strategies considered in the Region C plan.

5A.1.14 Other Measures - Renewal of Contracts

Many of the water users in Region C purchase water from a regional wholesale water provider or from another water supplier through contractual arrangements. For this plan it was assumed that existing water supply contracts will be renewed unless either entity indicated they were not planning to continue the contract. Renewal of a contract was not treated as a specific management strategy. In most cases in Region C, both the seller and the purchaser plan to renew existing contracts, and their long-term plans are based on the renewal of contracts. Contract increases are potentially feasible with the agreement of both parties.

Summary of Decision: Assume that existing contracts are renewed upon their expiration and do not consider renewal to be a water management strategy. Assume an increase in the amount of the contracts to meet projected needs with the agreement of both parties.

Table 5A.3
Potentially Feasible Interbasin Transfers for 2016 Region C Plan

Source	Basin of Origin	Receiving Basin	Maximum Amount[a] (Ac-Ft/Yr)	Comments
Lake Palestine	Neches	Trinity	110,670	Already permitted. 114,337 af/y is the permitted amount; 2030 WAM yield is 110,670 af/y.
Toledo Bend Reservoir	Sabine	Trinity	600,000	Connection of Existing Supply
Oklahoma Water	Red	Trinity	>165,000	Connection of Existing Supply
Marvin Nichols at elevation 313.5 (as part of Sulphur Basin Supplies)	Sulphur	Trinity	375,240	New Surface Water
Wright Patman pool raise (to 232.5, as part of Sulphur Basin Supplies)	Sulphur	Trinity	127,120	Connection of Existing Supply, Reallocation
Wright Patman – Texarkana	Sulphur	Trinity	100,000	Connection of Existing Supply,
Forest Grove Reservoir	Trinity	Neches	2,500	Connection of Existing Supply
Gulf of Mexico Desalination	Gulf of Mexico	Trinity	unlimited	Connection of Existing Supply, Desalination
NTWMD Lake Texoma-Authorized	Red	Trinity	113,000	Already permitted. Connection to Existing Supply, Desalination or Blend
GTUA Lake Texoma and Grayson County Project	Red	Trinity	56,500	Already permitted. Connection to Existing Supply, Desalination
Lake Texoma-Unauthorized	Red	Trinity	220,000	Connection of Existing Supply, Reallocation, Desalination or Blend
Cypress River Basin Supplies	Cypress	Trinity	unknown [b]	Connection of Existing Supply
Marvin Nichols Reservoir (328 msl)	Sulphur	Trinity	489,000	New Surface Water
Lower Bois d'Arc Creek Reservoir	Red	Trinity	120,200	New Surface Water
Lake Ralph Hall	Sulphur	Trinity	34,050	New Surface Water
George Parkhouse North Lake	Sulphur	Trinity	118,960	New Surface Water
George Parkhouse South Lake	Sulphur	Trinity	108,480	New Surface Water
Neches River Run-of-River Supplies	Neches	Trinity	47,250	18,000 af/y of interbasin transfer is already permitted (CA 06-3254C).
Lake Columbia	Neches	Trinity	56,050	New Surface Water

Notes: a. Volumes of supply listed in this table represent the maximum amount available from the source, which in some cases is greater than the volume that is being recommended in this plan.
b. The amount of supply available from Lake O' the Pines is unclear. See footnote for Table 5A.1.

5A.1.15 Other Measures

Groundwater Conservation Districts

Texas law allows for the establishment of groundwater conservation districts to help control the development and use of groundwater resources. Groundwater conservation districts can control well size and use, well spacing, and groundwater pumping. There are currently seven active groundwater conservation districts in Region C. These groundwater conservation districts may be an appropriate way to share a limited resource in areas where groundwater use exceeds or approaches the long-term reliable supply. Participation in such districts is a local decision and should be considered by water suppliers and government officials in areas of heavy groundwater use.

Summary of Decision: Local water suppliers and government officials should consider becoming active participants in groundwater conservation districts in areas of heavy groundwater use.

Supplemental Wells

In prior Region C Plans, supplemental wells (or replacement wells) were included as recommended water management strategies for all WUGs and WWPs that had a groundwater supply. Capital costs associated with these strategies reflected replacement of existing wells during the 50 year planning period. However, in this fourth cycle of regional planning, the regional planning rules explicitly prohibit the inclusion of replacement of existing infrastructure that does not provide additional volume of supply. These rules are specifically laid out in Section 5.1.2.3 of the Regional Planning Guidelines. It is Region C's understanding that supplemental wells are not permitted to be included in the 2016 Regional Water Plans. Because of this TWDB rule, supplemental wells have not been included in this plan and are no longer considered a WMS. However, the Region C Planning Group believes that the replacement of aging infrastructure, like wells, is an important part of maintaining an adequate water supply. Such projects should be considered consistent with this plan and supported by adequate state funding, where needed.

Summary of Decision: Do not include supplemental wells for groundwater users in Region C.

Sediment Control Structures

The accumulation of sediment in existing reservoirs can have a significant impact on the reliable supply from those reservoirs over time. For reservoirs in Region C, there is a projected reduction in reservoir yield of 43,000 acre-feet per year over the 50-year period from 2020 to 2070. For reservoirs outside Region C that supply water to Region C, there is a projected reduction in yield of 36,600 acre-feet per year over the same period.

Since the 1950s numerous dams and structures in Texas have been constructed to help reduce the amount of sediment carried downstream into water supply sources. Many of these structures are approaching the end of their useful life and will require rehabilitation or new structures. Studies conducted by the Tarrant Regional Water District in the Trinity River Basin estimate that existing Natural Resources

Conservation Service (NRCS) control structures provide considerable reductions in sediment loading to downstream reservoirs. In the West Fork System watershed, the cost per acre-foot of sediment retained was estimated by the District at $435. Based on the projected sediment accumulation in the lakes and the corresponding reduction in yield, the cost of water saved would be about $200 per acre-foot. This indicates sediment control structures can be very cost effective in selected watersheds. The control of sediment by these NRCS structures can also have water quality benefits for downstream streams and reservoirs.

Summary of Decision: Recommend the state support both federal and state efforts to rehabilitate existing sediment control structures and encourage funding and support for the construction of new structures in watersheds that would have the greatest benefits.

5A.1.16 Summary of Potentially Feasible Strategies

Appendix O includes a listing of potentially feasible water management strategies for Region C for Wholesale Water Providers and for all Water User Groups by County. Table 5A.4 lists potentially feasible strategies that would supply over 25,000 acre-feet per year for Region C. As the table shows, Region C considered and evaluated a wide variety of potentially feasible water management strategies. The results of the evaluation and the recommended strategies for Region C are discussed in Sections 4D, 4E, and 4F, and summarized in Appendix P. The methodology for the evaluation is discussed below.

5A.2 Methodology for Evaluating Water Management Strategies

The TWDB guidelines set forth certain factors that are to be considered by the regional water planning groups in the evaluation of water management strategies [2]:

- Evaluation of quantity, reliability, and cost of water delivered and treated
- Environmental factors including:
    - Environmental water needs
    - Wildlife habitat
    - Threatened and endangered species
    - Cultural resources
    - Bays and estuaries
- Impacts on other water resources
- Impacts on threats to agricultural and natural resources
- Other factors deemed relevant by the planning group

- Equitable comparison of all feasible strategies
- Consideration of interbasin transfer requirements in the Texas Water Code and other regulatory requirements
- Consideration of third party social and economic impacts of voluntary redistributions of water.

This subsection discusses the specific evaluation factors selected by the Region C Water Planning Group for the potentially feasible water management strategies, including the environmental evaluation of alternatives and the development of costs. Additional details on the environmental evaluations, the development of costs, and the evaluation of strategies are included in various appendices.

Table 5A.4
Potentially Feasible Water Management Strategies for Region C
Supplying 25,000 Acre-Feet per Year or More

Strategy	Potential Sponsor(s)	Maximum Supply [a] Available to Region C in Acre-Feet per Year	Recommended in 2011 Plan?
Conservation (not including built-in conservation savings)	Multiple	135,991	Yes
Reuse (Including reuse projects listed below)	Multiple	355,118	Yes
Toledo Bend Reservoir	SRA, NTMWD, TRWD, DWU, and UTRWD	600,000	Yes
Gulf of Mexico with Desalination	DWU, NTMWD, and TRWD	Unlimited	No
Sulphur Basin Supplies (Marvin Nichols (313.5 msl) and reallocation of Wright Patman)	DWU, NTMWD, TRWD, UTRWD, and Irving	502,360	No
Marvin Nichols Reservoir (at elevation 328)	DWU, NTMWD, TRWD, UTRWD, and Irving	489,000	Yes
Lake Texoma – Unauthorized (Blend or Desalination)	NTMWD, DWU, or UTRWD	220,000	No (alternative)
Oklahoma Water	NTMWD, TRWD, UTRWD, and Irving	165,000 or more	Yes
Main Stem Trinity River Pump Station & Balancing Reservoir (Reuse)	DWU	149,093	No
TRWD Integrated Pipeline and Reuse	TRWD	123,100	Yes
Lower Bois d'Arc Creek Reservoir	NTMWD	120,200	Yes
George Parkhouse Lake (North)	NTMWD and UTRWD	118,960	No (alternative)
NTWMD Lake Texoma – Authorized (Blend)	NTMWD	113,000	Yes
Lake Palestine (Integrated Pipeline with TRWD)	DWU	110,670	Yes
George Parkhouse Lake (South)	NTMWD and UTRWD	108,480	No (alternative)
Wright Patman Lake – Texarkana	DWU, NTMWD, TRWD, or UTRWD	100,000	No
Carrizo-Wilcox Groundwater (Smith, Wood, Upshur Counties)	DWU	102,930	No
Cypress River Basin Supplies (Lake O' the Pines)	DWU, NTMWD, or TRWD	unknown	No
Ellis County Water Supply Project	TRA/ TRWD/Ellis County Suppliers	74,610	Yes
Lake Columbia	DWU	56,050	No
Main Stem Trinity River Pump Station – TRA Reuse	NTWMD	53,088	Yes, with different source
Neches River Run-of-River	DWU	47,250	No
Tehuacana Reservoir	TRWD	41,600	No (alternative)
GTUA Lake Texoma (Desalination)	GTUA	56,500	Yes

Strategy	Potential Sponsor(s)	Maximum Supply [a] Available to Region C in Acre-Feet per Year	Recommended in 2011 Plan?
Lake Ralph Hall with Reuse	UTRWD	52,437 [c]	Yes
Carrizo-Wilcox Groundwater (Freestone and Anderson Counties)	NTWMD	42,000	No
TRA Contract with Irving for Reuse	TRA and Irving	28,025	Yes
NTMWD/GTUA Collin Grayson Municipal Alliance	Multiple	30,000	Yes

Notes: a. Volumes of supply listed in this table represent the maximum amount available from the source, which in some cases is greater than the volume that is being recommended in this plan.
b. The amount of supply available from Lake O' the Pines is unclear. See footnote for Table 5A.1.
c. Includes ultimate reuse amount.

5A.2.1 Factors Considered in Evaluation

Table 5A.5 sets out the factors specifically considered by the Region C Water Planning Group in the evaluation of potential water management strategies. As required, the evaluation of water management strategies includes the quantitative reporting of quantity, reliability, costs and environmental factors. While the quantitative reporting of water made available and the unit cost of delivered and treated water can readily be developed, data for the quantitative reporting of environmental factors are limited. The detailed quantitative assessment of environmental factors requires data from site-specific studies, which are often not conducted at the planning level. Available data for environmental factors are used in the evaluation.

Consistency with plans of Region C water suppliers is an important factor in the evaluation of strategies. It is the intent of the Region C Water Planning Group to build the Region C Water Plan considering the existing plans of the water suppliers in the region, especially the regional wholesale water providers.

Equitable comparison of all feasible strategies is not included as an explicit evaluation factor because it describes the way that the entire evaluation was conducted. This factor was considered in the development of the methodology for evaluations. Interbasin transfer requirements in the Texas Water Code were considered in the development of strategies. Appendix P gives more details on the evaluation of potentially feasible water management strategies for Region C.

Table 5A.5
Factors Used to Evaluate Water Management Strategies for Region C

Quantity of Water Made Available
Reliability of Supply
Unit Cost of Delivered and Treated Water
Environmental Factors
- Total Acres Impacted
- Wetland Acres
- Environmental Water Needs
- Wildlife Habitat
- Threatened and Endangered Species
- Cultural Resources
- Bay and Estuary Flows
- Water Quality
- Other
Impacts on Agricultural and Rural Areas
Impacts on Natural Resources
Impacts on Other Water Management Strategies and Possible Third Party Impacts
Impacts to Key Water Quality Parameters
Consistency with Plans of Region C Water Suppliers
Consistency with Other Regions

5A.2.2 Environmental Evaluation

The environmental evaluation of potentially feasible management strategies is summarized in Appendix P. Factors reported quantitatively include the total acres impacted by the strategy and the number of threatened and endangered species listed in the counties of the proposed water source. For existing water sources, only the species that are water dependent are included in the count of threatened and endangered species. Other factors were assigned a high, moderate, or low rating based on existing data and the potential to avoid or mitigate each of the environmental categories listed in Table 5A.5. These evaluations were summarized in an overall environmental evaluation for the strategy. Certain management strategies were evaluated as a category rather than individually because their environmental effects do not vary greatly. Examples of evaluation by category include purchasing water from another provider and development of new wells in aquifers with additional water available.

5A.2.3 Agricultural Resources and Other Natural Resources

The evaluation of impacts to agricultural resources and rural areas assesses the ability to continue current agricultural and livestock activities. Strategies that move considerable amounts of water from rural to urban areas were also considered under this category. The impacts of recommended strategies on these factors are discussed in more detail in Chapter 6.

Impacts to other natural resources include potential impacts to water resources that are not the direct source for the strategy and impacts to mineral resources, oil and gas, timber resources, and parks and public lands. (Impacts to the water resources that are the source for the strategy are included under environmental factors.) The considerations of the impacts to agricultural and natural resources are used to assess how the regional water plan is consistent with the protection of the state's resources. This discussion is summarized in Chapter 6 of the plan.

5A.2.4 Costs of Water Management Strategies

Appendix Q contains more detailed information on the development of cost estimates for individual water management strategies. Development of cost estimates followed guidelines provided by the Texas Water Development Board. The assumptions used for the cost estimates are outlined in Appendix Q. For equitable comparison of the water management strategies, capital costs for all strategies were assumed to be financed by 20–year bonds, with the exception of reservoirs which were financed by 40-year bonds. The discounted present value of each potentially feasible strategy will be calculated by the Texas Water Development Board. The costs shown in Appendix Q are the unit costs during and after payment of debt service.

5A.2.5 Recommended Water Management Strategies

Water management strategies are recommended based on the overall factors set forth in the strategy evaluations. As discussed above, consistency with the on-going water development plans of regional water providers is an important factor in the strategy selection. All factors listed in Table 5A.5 were considered in the selection process. The recommended strategies are based on the ability to supply the quantity of water needed at a reasonable cost, while providing long-term protection of the state's resources. Recommended strategies for Region C are discussed in the following Sections 5C and 5D.

SECTION 5A
LIST OF REFERENCES

(1) Texas Water Development Board: *Water for Texas – 2012*, Austin, January 2012.

(2) Texas Water Development Board: Chapter 357, Regional Water Planning Guidelines, Austin, August 12, 2012.

(3) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: 2011 Region C Water Plan, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

(4) U.S. Army Corps of Engineers, Tulsa District, Final Environmental Assessment, Lake Texoma Storage Reallocation Study, Lake Texoma, Oklahoma and Texas, Tulsa, May 2006. Available URL: http://www.swt.usace.army.mil/library/Lake%20Texoma%20Reallocation%20Study/2006/FINAL%20LAKE%20TEXOMA%20EA%20060106.pdf

(5) Texas State Soil and Water Conservation Board, State Brush Control Plan, Temple, [ONLINE], Available URL: http://www.tsswcb.state.tx.us/files/docs/brush/statebrushplans/Brush_Control_Plan_2007_0.pdf, 2007.

5B Evaluation of Major Water Management Strategies

This section of the report reviews the evaluation of major potentially feasible water management strategies. Major strategies are defined as those that would supply more than 30,000 acre-feet per year and those that involve the construction of a new reservoir supplying over 1,000 acre-feet per year. Table 5B.1 lists the major potentially feasible water management strategies for Region C, and Figure 5B.1 shows the location of the water supplies for the major strategies considered.

As discussed in Section 5A, potentially feasible water management strategies for Region C were evaluated on the basis of quantity, reliability, cost, environmental factors, impacts on agricultural and rural areas, impacts on natural resources, impacts on other water management strategies and third party impacts, impacts to key water quality parameters, consistency with plans of Region C water suppliers, and consistency with the plans of other regions. The yield for reservoirs and run-of-river supplies located in Texas are calculated using the TCEQ-approved Water Availability Models (Run 3). The supply available for the reservoirs was limited to the minimum of the WAM firm (or safe) yield or the permit amount. (Region C was granted a variance by TWDB to use safe yield for Tarrant Regional Water District supplies and Dallas Water Utility supplies.) Supply from Oklahoma sources has been estimated using standard hydrologic practices.

Table 5B.1 summarizes the evaluation of the major potentially feasible strategies (see Appendix P for the evaluation of environmental factors). Appendix P gives more details on non-cost evaluations for the strategies, and Appendix Q contains detailed cost estimates. Figure 5B.2 shows the comparative unit costs of the strategies. The costs shown in Table 5B.1 and Figure 5B.2 should be used with caution. The costs for a given source can vary a great deal based on the amount used and where the water is delivered.

The remainder of this section discusses the evaluations of the specific potentially feasible major water management strategies for Region C. (Conservation strategies are discussed in Section 5E.)

5B.1 Toledo Bend Reservoir

Toledo Bend Reservoir is an existing impoundment located in the Sabine River Basin on the border between Texas and Louisiana. It was built in the 1960s by the Sabine River Authority of Texas (SRA) and the Sabine River Authority of Louisiana. The yield of the project is split equally between the two states, and Texas' share of the yield is slightly over 1,000,000 acre-feet per year [(2)]. The SRA holds a Texas water right to divert 750,000 acre-feet per year from Toledo Bend and is seeking the right to divert an additional 293,300 acre-feet per year.

The Metroplex water suppliers have been investigating the possibility of developing substantial water supplies from Toledo Bend Reservoir, with up to 348,000 acre-feet per year delivered to Region C. (Toledo Bend Reservoir is located in Region I, the East Texas Region.) The development of this supply will require an agreement among the SRA and Metroplex suppliers, an interbasin transfer permit from the Sabine River Basin to the Trinity River Basin, and development of water transmission facilities. Because Toledo Bend Reservoir is so far from Region C (about 200 miles), this is a relatively expensive source of supply for the Region. However, it does offer a substantial water supply, and environmental impacts will be limited because it is an existing source.

Supply from Toledo Bend is identified as a recommended strategy for North Texas Municipal Water District and as an alternative strategy for Dallas, TRWD, NTMWD, and UTRWD. The recommended strategy for the North Texas Municipal Water District is for 100,000 acre-feet per year. NTWMD hopes to connect to Toledo Bend Reservoir by 2060. The capital cost for this recommended strategy is $1.2 billion. The alternative strategy for Tarrant Regional Water District, North Texas Municipal Water District, and the Upper Trinity Regional Water District is to develop a total supply of approximately 348,000 acre-feet per year. The Region C capital cost of the alternative strategy is $5.1 billion. Toledo Bend is also identified as an alternative strategy for Dallas Water Utilities. The supply developed from this alternative strategy is approximately 200,000 acre-feet per year and the capital cost for this alternative strategy is $2.3 billion.

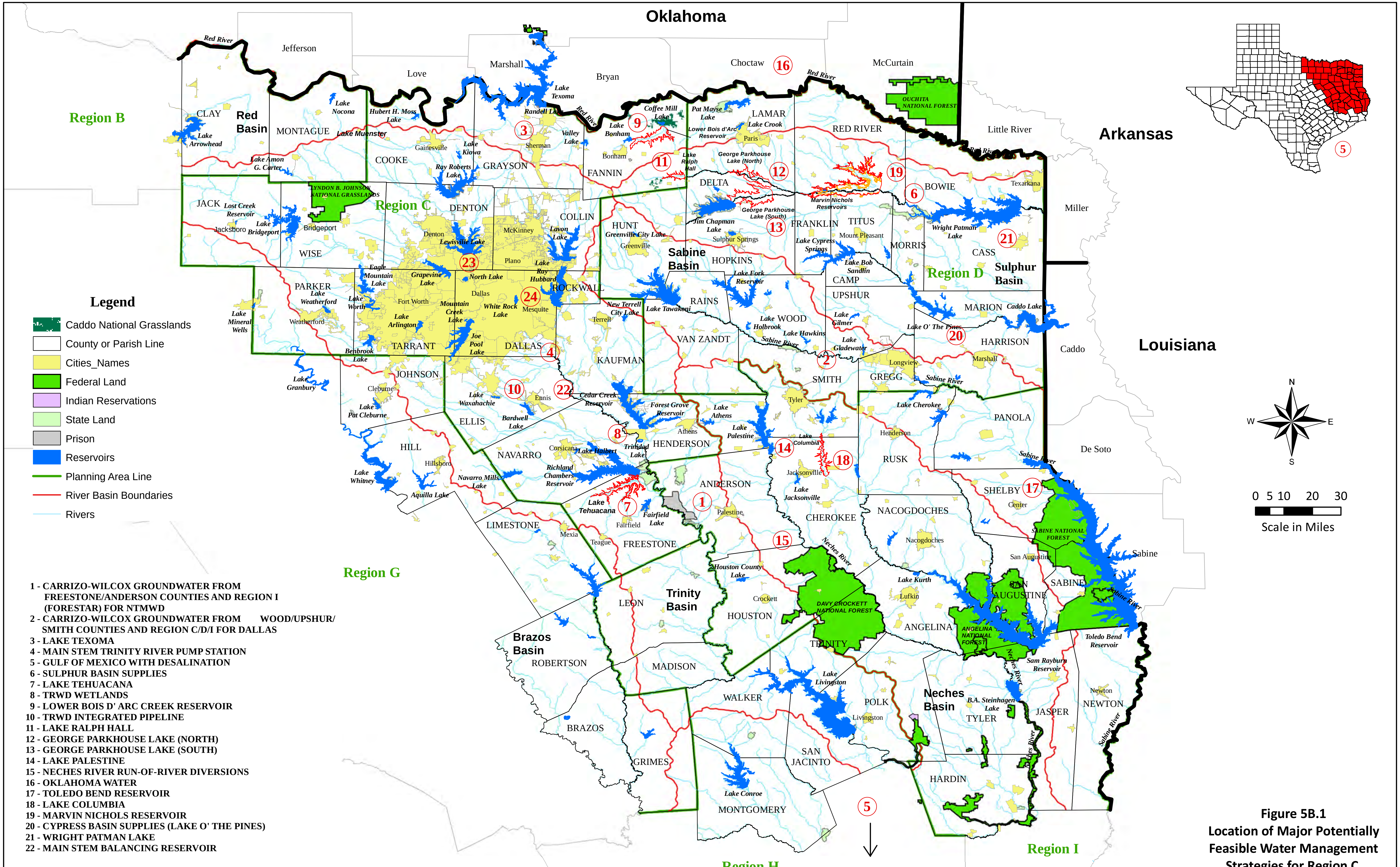


Figure 5B.1
Location of Major Potentially Feasible Water Management Strategies for Region C

Table 5B. 1
Summary of Costs and Impacts of Major Potentially Feasible Strategies for Region C

Strategy	Potential Supplier(s)	Potential Region C Supply (Acre-Feet per Year)	Region C Share of Capital Cost	Unit Cost for Region C ($/1,000 Gal.)		Reliability[c]	Impacts of Strategy on[c]:				Consistency		Implementation Issues	Location Number in Figure 5B.1	Comments
				With Debt Service	After Debt Paid		Agricultural Resources/Rural Areas	Other Natural Resources	3rd Party Impacts	Key Water Quality Parameters	Suppliers	Other Regions			
Toledo Bend Reservoir (Recommended)	NTMWD	100,000	$1,248,461,000	$4.07	$0.95	High	Low	Low	Medium low	Medium Low	Yes	Yes	Requires IBT.	17	
Toledo Bend Reservoir (Alternative)	TRWD, NTMWD, UTRWD	348,000	$5,138,594,000	$4.83	$1.02	High	Low	Low	Medium low	Medium Low	Yes	Yes	Requires IBT and agreements with multiple users.	17	Cost is the total for all participants.
Toledo Bend Reservoir (Alternative)	DWU	200,659	$2,290,065,000	$3.73	$0.80	High	Low	Low	Medium low	Medium Low	Yes	Yes	Requires IBT and agreements with multiple users.	17	
Gulf of Mexico (Potentially Feasible Strategy)	TRWD, DWU, or NTMWD	Unlimited (costs for 200,000 acre-feet per year)	$4,311,027,000	$8.36	$2.82	High	Low	Medium Low	Low	Medium Low	No	N/A	Technology is still developing for this application at this scale. May require state water right permit and IBT.	5	Strategy was costed to central location. Capital cost was based on supplier. Supply is treated water.
Sulphur Basin Supplies (Recommended)	NTMWD, TRWD and UTRWD	489,800	$4,516,545,000	$2.96	$0.73	High	High	Medium high	High	Medium Low	Yes	Not inconsistent	Requires new water rights permit and IBT. Known public opposition.	6	
Sulphur Basin Supplies (Alternative)	DWU and Irving	489,800	$4,758,685,000	$3.72	$0.79	High	High	Medium high	High	Medium Low	Yes	Not inconsistent	Requires new water rights permit and IBT. Known public opposition.	6	This is an alternative strategy for DWU and Irving, but costs were developed assuming DWU, Irving, UTRWD, NTMWD, and TRWD participate.
Marvin Nichols Strategy (Alternative)	NTMWD, TRWD, UTRWD, and Irving	489,800	$4,321,909,000	$2.98	$0.74	High	High	Medium high	High	Medium Low	Yes	Not inconsistent	Requires new water rights permit and IBT. Known public opposition.	19	
Lake Texoma Authorized Blend (LBA and SBS) (Recommended)	NTMWD	97,838	$521,775,000	$3.56	$0.90	High	Low	Medium	Medium Low	Medium	Yes	N/A	Water quality in blended water.	3	
Lake Texoma Not Yet Authorized (Desalinate) (Alternative)	DWU	146,000	$1,517,474,000	$4.57	$1.91	High	Low	Medium	Medium Low	Medium	No (alternative)	N/A	Requires IBT, state water right, Congressional authorization, and contract with USACE.	3	Delivers treated water.
Lake Texoma Authorized (Desalinate) (Alternative)	NTMWD	39,235	$622,592,000	$7.20	$2.96	High	Low	Medium	Medium Low	Medium	No (alternative)	N/A	Requires IBT	3	Delivers treated water.

Table 5B.1, Continued

Strategy	Potential Supplier(s)	Potential Region C Supply (Acre-Feet per Year)	Region C Share of Capital Cost	Unit Cost for Region C ($/1,000 Gal.)		Reliability	Impacts of Strategy on[c]:				Consistency		Implementation Issues	Location Number in Figure 5B.1	Comments
				With Debt Service	After Debt Paid		Agricultural Resources/Rural Areas	Other Natural Resources	3rd Party Impacts	Key Water Quality Parameters	Suppliers	Other Regions			
Oklahoma Water (Recommended)	NTMWD	50,000	$167,541,000	$1.56	$0.70	High	Low	Low	Medium Low	Medium Low	Yes	N/A	Oklahoma has moratorium for export of water out of state.	16	
Oklahoma Water (Alternative)	TRWD and UTRWD	65,000	$264,054,500	$2.82	$0.87	High	Low	Low	Medium Low	Medium Low	Yes	N/A		16	Cost is the average cost for TRWD and UTRWD.
TRWD Integrated Pipeline (Recommended)	TRWD	179,000	$1,733,914,000	$3.33	$0.73	High	Low	Low	Medium Low	Low	Yes	N/A		10	Pipeline delivers existing supplies.
Lower Bois d'Arc Creek Reservoir (Recommended)	NTMWD	120,200	$625,610,000	$1.55	$0.22	High	Medium	Medium	Medium	Medium Low	Yes	N/A	Requires new water rights permit and IBT.	9	
George Parkhouse Lake North (Alternative)	NTMWD or UTRWD	118,960	$528,450,500	$2.28	$0.46	High	High	Medium	Medium	Medium Low	No (alternative)	Not inconsistent	Requires new water rights permit and IBT.	12	Cost is the average cost for NTMWD and UTRWD.
Lake Palestine[d] (DWU Integrated Pipeline with TRWD) (Recommended)	DWU	110,670	$900,817,000	$4.68	$2.56	High	Low	Low	Medium Low	Medium	Yes	Yes	DWU has IBT permit.	14	
Neches River Run-of-River Diversion (Recommended)	DWU	47,250	$226,790,000	$2.14	$0.91	High	Low	Medium Low	Medium Low	Medium Low	Yes	Not inconsistent	Requires new water rights permit and IBT.	15	18,000 af/y is already permitted IBT.
George Parkhouse Lake (South) (Alternative)	NTMWD or UTRWD	108,480	$624,188,000	$2.57	$0.40	High	High	Medium	Medium	Medium Low	No (alternative)	Not inconsistent	Requires new water rights permit and IBT.	13	Cost is the average cost for NTMWD and UTRWD.
TRWD Wetlands (Recommended) [a]	TRWD	126,693 (Cost estimated for 88,059 acre-feet year)	$139,078,000	$1.28	$0.35	High	Low	Low	Low	Medium	Yes	N/A	TRWD has permit for reuse.	8	
Carrizo-Wilcox Groundwater (Freestone County) (Alternative)	NTMWD	42,000	$230,043,000	$1.86	$0.45	High	Low	Medium Low	Medium	Medium Low	No (alternative)	No	Requires coordination with local groundwater districts. Competing uses for water.	1	
Carrizo-Wilcox Groundwater Wood/Upshur/Smith (Alternative)	DWU	30,267	$161,063,000	$2.06	$0.69	High	Low	Medium High	Medium	Medium	No (alternative)	No	Requires coordination with local groundwater districts. Competing uses for water.	2	
Cypress Basin Supplies (Lake O' the Pines) (Alternative)	NTMWD	87,900	$361,876,000	$1.66	$0.74	High	Low	Low	Medium Low	Medium Low	No (alternative)	Not inconsistent	Requires IBT, renegotiating existing contracts, & contract with NETMWD.	20	
Main Stem Trinity River Pump Station (Recommended)	DWU and NTMWD	87,839	$116,224,000	$0.47	$0.14	High	Low	Low	Low	Medium	Yes	N/A	Requires water right permit amendment.	4	
Main Stem Balancing Reservoir (Recommended)	DWU	114,342	$674,463,000	$1.86	$0.54	High	Low	Low	Low	Medium	Yes	N/A	Requires water right permit amendment.	22	
Tehuacana Reservoir (Recommended)	TRWD	41,600	$742,730,000	$4.24	$0.46	High	Medium high	Medium	Medium	Medium Low	No (alternative)	N/A	Requires new water rights permit.	7	
Lake Ralph Hall and Reuse (Recommended) [b]	UTRWD	52,437	$316,160,000	$1.79	$0.25	High	High	Medium Low	Medium Low	Medium Low	Yes	N/A	Requires IBT. Water right obtained	11	Costs are based on total from reservoir and ultimate reuse
Lake Columbia (Recommended)	DWU	56,050	$327,187,000	$2.80	$1.48	High	Low	Medium	Medium	Medium	No (alternative)	Yes	Requires contract with ANRA and IBT.	18	

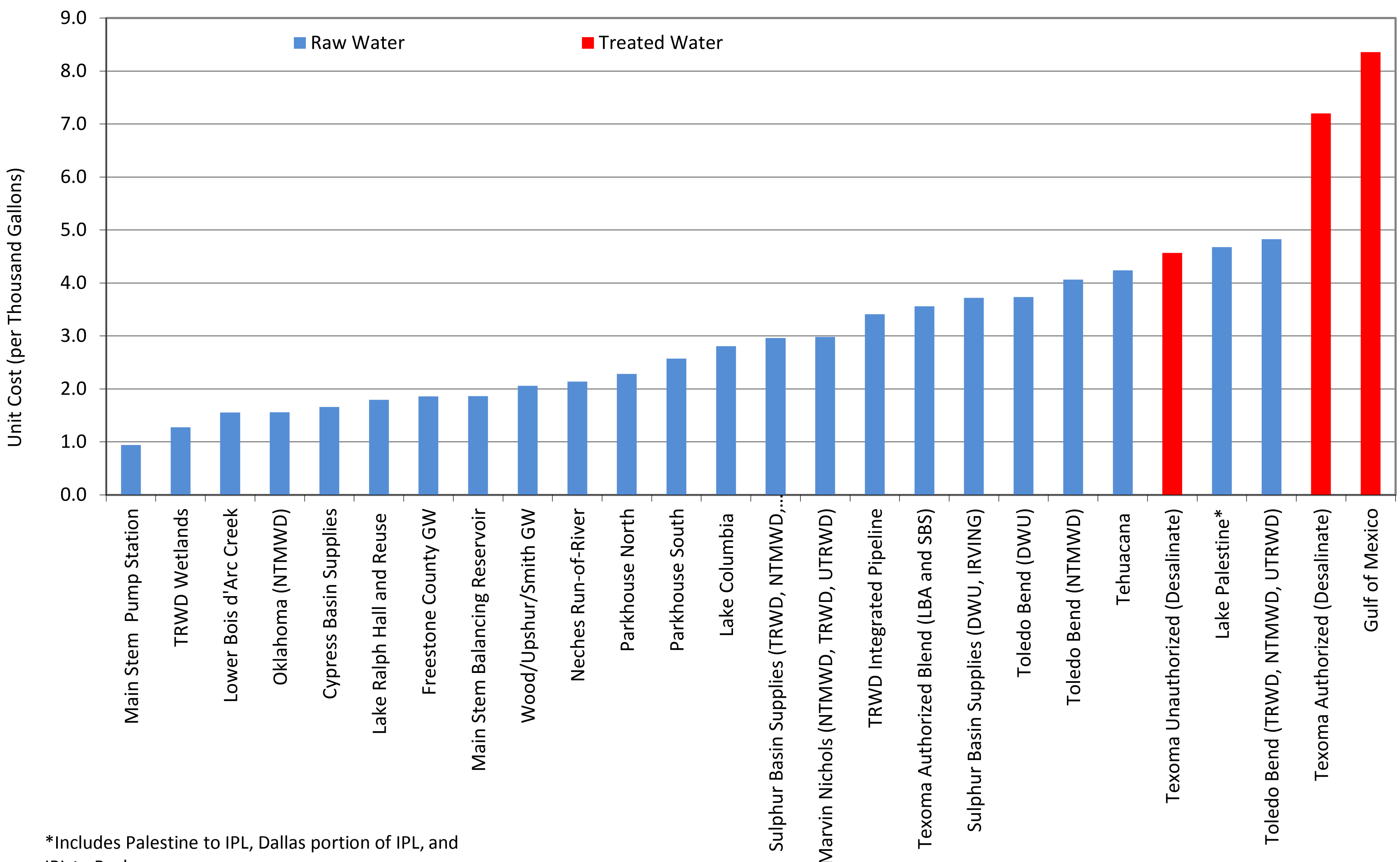
[a] This volume is included is TRWD Integrated Pipeline above.

[b] Ultimate volume. 2070 volume is 50,121 ac-ft/yr.

[c] Rankings are based on quantitative data contained in Tables P.3 and P.4 of Appendix P.

[d] Cost is for connection from Lake Palestine to IPL and connection to Bachman WTP. The cost of the IPL is included separately.

Figure 5B. 2
Unit Costs of Potentially Feasible Major Strategies for Region C



*Includes Palestine to IPL, Dallas portion of IPL, and IPL to Bachman

5B.2 Gulf of Mexico with Desalination

The cost of desalination has been decreasing in recent years, and some municipalities in Florida and California have been developing desalinated seawater as a supply source. The State of Texas has sponsored initial studies of potential seawater desalination projects [3], and this is seen as a potential future supply source for the state. Because of the cost of desalination and the distance to the Gulf of Mexico, seawater desalination is not a particularly promising source of supply for Region C. However, seawater desalination has been mentioned through public input during the planning process, and it was evaluated in response to that input.

The supply from seawater desalination is essentially unlimited, but the cost is a great deal higher than the cost of other water management strategies for Region C. Developing water from the Gulf of Mexico with desalination is not a recommended or alternative strategy for any water supplier in Region C.

5B.3 Sulphur Basin Supplies

Previously recommended or alternative water management strategies from the Sulphur River Basin in past Region C Plans include: Marvin Nichols Reservoir, Wright Patman Lake (including reallocation of flood storage), Lake George Parkhouse North, and Lake George Parkhouse South. All of these reservoirs are located in the Region D (North East Texas) Regional Water Planning Area. Marvin Nichols Reservoir would be located on the Sulphur River upstream from its confluence with White Oak Creek. The dam would be in Titus and Red River counties and would also impound water in Franklin County. Wright Patman Lake is an existing reservoir on the Sulphur River, about 150 miles from the Metroplex. It is owned and operated by the U.S. Army Corps of Engineers, and the City of Texarkana has contracted with the Corps of Engineers for storage in the lake and holds a Texas water right to use up to 180,000 acre-feet per year from the lake. The two Parkhouse reservoirs are described later in this chapter.

The Region C entities that are interested in development of Sulphur Basin Supplies (NTMWD, TRWD, Dallas, UTRWD, and Irving), along with the Sulphur River Basin Authority, have formed a Joint Committee on Program Development (JCPD). Since 2001, the JCPD has provided more than $5 million to the SRBA to further investigate the development of potential water supply sources in the Sulphur River Basin. Ongoing Sulphur Basin Feasibility studies are being conducted by the U.S. Army Corps of Engineers, SRBA and the JCPD. At the direction of SRBA and the JCPD, these ongoing studies are seeking to address concerns from Region D entities regarding the protection of natural resources, environmental impacts, and the socio-economic impacts of developing water supply within Region D and the Sulphur Basin. As a result, these ongoing studies have identified additional options for water supply in the Sulphur Basin that may address concerns from Region D and would also develop supply needed for Region C and Region D entities.

As identified in the 2014 Sulphur River Basin studies [(14)], this *2016 Region C Water Plan* recommends a combined strategy of Marvin Nichols Reservoir with the reallocation of flood storage to conservation storage in Wright Patman Lake. This combination is referred to in this report as the Sulphur Basin Supplies strategy. The combination strategy may enable the Marvin Nichols Reservoir to be developed with a smaller footprint. The proposed Sulphur Basin Supplies strategy would yield nearly 600,000 acre-feet per year (calculated using TCEQ WAM models, assuming Lake Ralph Hall is senior, and accounting for environmental flows). The Sulphur Basin Supplies strategy is a recommended water management strategy for NTMWD, UTRWD, and TRWD. It is also an alternative strategy for Dallas and the City of Irving. Approximately 80 percent of the water supplied from the Sulphur Basin Supplies strategy is expected to serve customers of wholesale water providers in Region C and approximately 20 percent would serve water needs in Region D.

The 2014 Sulphur River Basin studies [(14)] evaluated a total of sixty combinations of alternative scales and locations of new surface water development in the Sulphur Basin. Based on these analyses, ongoing strategy optimization is focused on reallocated storage at Wright Patman between elevation 232.5 and elevation 242.5 in combination with new storage at the Marvin Nichols site. For the purpose of the 2016 Region C Plan, the Sulphur Basin Supplies Strategy assumes the reallocation of Wright Patman to 232.5 and new storage at Marvin Nichols site for a conservation pool elevation of 313.5. (Appendix P contains a technical memo and strategy analysis of the Sulphur Basin Supplies which shows the division of yield between the Wright Patman portion and the Marvin Nichols portion, as well as the proposed allocations of that yield to Region C users that has been assumed for this regional plan. Appendix Y contains a detailed quantitative analysis on the Marvin Nichols (313.5 msl) portion of the Sulphur Basin Supplies strategy.)

In July 2015, the Region D Water Planning Group raised an objection to the inclusion of the Marvin Nichols Reservoir (as part of the Sulphur Basin Supplies strategy) in the 2016 Region C Initially Prepared Plan. Subsequent to this objection, TWDB determined that an interregional conflict did exist between the Region C and D IPPs and ordered mediation to resolve the conflict. Based on the resulting mediation agreement, the Marvin Nichols portion of the Sulphur Basin Supplies strategy has been modified to begin in 2070 rather than in 2050 (as it was presented in the IPP). The Wright Patman portion of the Sulphur

Basin Supplies strategy is still shown beginning in 2050. Further information on this 2016 Interregional Conflict is presented in Section 10.6 of this report.

As with most major reservoir projects, the Sulphur Basin Supplies strategy will have significant environmental impacts. At the conservation pool elevations mentioned above, the Marvin Nichols component would inundate an estimated 41,722 acres, while the pool raise at Wright Patman Lake would inundate an additional 9,429 acres over and above the current "average" conservation pool elevation. Of that additional acreage, the Corps of Engineers has estimated that 7,126 acres are not currently owned by the U.S. Government in a fee title interest and would require purchase. Studies are currently underway to optimize the combination in terms of cost, environmental, and social impacts, and the final strategy may differ somewhat in terms of specific elevation at either or both components of the project.

The 1984 U.S. Fish and Wildlife Service Bottomland Hardwood Preservation Program [(5)] classified some of the land that would be flooded as a Priority 1 bottomland hardwood site, which is "excellent quality bottomlands of high value to key waterfowl species." The proposed location of the Marvin Nichols Reservoir (313.5 msl) will reduce but not eliminate the impact on bottomland hardwoods compared to the Marvin Nichols reservoir at elevation 328 feet, msl proposed in previous Region C Water Plans. Permitting the project and developing appropriate mitigation for the unavoidable impacts will require years, and it is important that water suppliers start that process well in advance of the need for water from the project. Development of the Sulphur Basin Supplies will require interbasin transfer permits to bring the water from the Sulphur River Basin to the Trinity River Basin. The project will include a major water transmission system to bring the new supply to the Metroplex. The project will make a substantial water supply available to the Metroplex, and the unit cost is less than that of most other major water management strategies.

As discussed in Section 5C, the Sulphur Basin Supplies is a recommended strategy for the North Texas Municipal Water District (174,800 acre-feet per year), the Tarrant Regional Water District (280,000 acre-feet per year), and Upper Trinity Regional Water District (35,000 acre-feet per year). Further quantitative data for this recommended strategy is contained in Appendix P and Appendix Y. The Sulphur Basin Supplies is an alternative strategy for Dallas Water Utilities and the city of Irving. The Region C capital cost for the recommended strategy is $4.5 billion. The capital cost for the alternative strategy involving Dallas Water Utilities and City of Irving is approximately $4.8 billion.

5B.4 Marvin Nichols (elevation 328 msl) Strategy

The larger configuration of Marvin Nichols Reservoir (at elevation 328 feet, msl) that was included in the previous three Region C Water Plans (2001, 2006, and 2011) is being retained as an alternative strategy for the *2016 Region C Water Plan.* This strategy is being retained as an alternative because Region C recognizes that there are inherent risks and impacts associated with Sulphur Basin Supplies (described in Section 5B.3 above) which may prevent it from being implemented, particularly the reallocation of flood storage at Wright Patman Lake (see paragraph below for further detail). The Marvin Nichols 328 feet, msl strategy is an alternative strategy for NTMWD, TRWD, UTRWD, and Irving. The total capital cost for this alternative strategy is expected to be approximately $4.3 billion. The amount of supply expected to be used by Region C for this alternative strategy would be 489,800 acre-feet per year (with 20 percent of the yield being used locally in Region D). Further quantitative data for this alternative strategy is contained in Appendix P and Appendix Y. Based on the interregional conflict resolution agreement reached between Regions C and D, the Marvin Nichols (328 feet, msl) alternative strategy would not be online until 2070 for any participants.

Reallocation of flood storage at Wright Patman Lake at the scale envisioned for the Sulphur Basin Supplies strategy will require recommendation by the Corps of Engineers/Department of the Army and approval by the United States Congress. Prior to making a recommendation, the Corps will need to conduct a detailed evaluation of impacts associated with raising the conservation pool elevation. Potentially significant impacts could include inundation of natural resources within the flood pool, loss of flood protection downstream, increased impacts to cultural resources on the reservoir perimeter, effects on the Congressionally-established White Oak Creek Mitigation Area in the upper reaches of the Wright Patman flood pool, and reduced flexibility in International Paper's effluent management operations downstream of the dam. Wright Patman reallocation may also be constrained by Dam Safety considerations. As more detailed studies seek to develop an understanding of the tradeoffs between the environmental impacts at Wright Patman in comparison with the predicted impacts of new storage at the Marvin Nichols site, the risk exists that Patman reallocation may be constrained by either policy or environmental issues, or both.

5B.5 Lake Texoma

Lake Texoma is an existing Corps of Engineers reservoir on the Red River on the border between Texas and Oklahoma. Under the terms of the Red River Compact, the yield of Lake Texoma is divided equally between Texas and Oklahoma. Lake Texoma is used for water supply, hydropower generation, flood control, and recreation. In Texas, the North Texas Municipal Water District, the Greater Texoma Utility Authority, the City of Denison, TXU, and the Red River Authority have contracts with the Corps of Engineers and Texas water rights allowing them to use water from Lake Texoma [(7)].

The U.S. Congress has passed a law allowing the Corps to reallocate an additional 300,000 acre-feet of storage in Lake Texoma from hydropower use to water supply, 150,000 acre-feet for Texas and 150,000 acre-feet for Oklahoma. The North Texas Municipal Water District has purchased 100,000 of the 150,000 acre-feet of storage for Texas and has a Texas water right to divert an additional 113,000 acre-feet per year from Lake Texoma. The remaining 50,000 acre-feet of storage has been purchased by Greater Texoma Utility Authority, which has a Texas water right to divert an additional 56,500 acre-feet per year based on this storage.

Further reallocation of hydropower storage to water supply in Lake Texoma would provide additional yield. According to the Corps of Engineers, the firm yield of Lake Texoma with all hydropower storage reallocated to water supply would be 1,088,500 acre-feet per year [(8)]. Texas' share would be 544,250 acre-feet per year, leaving about 220,000 acre-feet per year of additional supply available to Texas by the reallocation of more hydropower storage to municipal use (beyond the supplies already contracted for and the currently authorized reallocation). Further reallocation would require a new authorization by Congress.

Lake Texoma is only about 50 miles from the Metroplex. The lake has elevated levels of dissolved solids, and the water must be blended with higher quality water or desalinated for municipal use. The elevated dissolved solids in Lake Texoma would have some environmental impacts whether the water is used by blending or desalination. Use for most Region C needs will require an interbasin transfer permit. Blending water from Lake Texoma with water from other sources provides an inexpensive supply for Region C. Blending Lake Texoma supplies with potential supplies from Lower Bois d'Arc Creek Reservoir and the Sulphur Basin Supplies strategy is a recommended strategy for North Texas Municipal Water District. The recommended strategy provides approximately 98,000 acre-feet per year for North Texas Municipal Water District.

Desalination provides treated water but is a more expensive strategy, and there are uncertainties in the long-term costs. The estimated costs for desalination of water from Lake Texoma are based on current cost information for large desalination facilities. However, they are more uncertain than other cost estimates in this plan for a number of reasons. There is not an established track record of success in the development of large brackish water desalination facilities. Most of the large desalination facilities built to date are located on or near the coast. If a 100 million gallon per day or larger plant were to be developed for Lake Texoma water, it would be the largest inland desalination facility in the world. In addition, the method and cost of brine disposal for such a facility are uncertain. Brine disposal has the potential to significantly increase the estimated cost for desalination. Detailed studies to solidify the cost estimates will be required if this strategy is pursued. Desalination of Lake Texoma was evaluated as an alternative strategy for North Texas Municipal Water District and Dallas Water Utilities. North Texas Municipal Water District's desalination strategy will be implemented at a location north of the Metroplex. The supply available from this strategy is approximately 39,235 acre-feet per year and the capital cost for this strategy is approximately $623 million. Dallas Water Utilities is proposing a strategy based on the supplies at Lake Texoma that are not authorized. The strategy will develop approximately 146,000 acre-feet per year with a capital cost of $ 1.5 billion.

As discussed in Section 5C, Lake Texoma is a recommended source of additional water supply for the North Texas Municipal Water District (blending with Lower Bois d'Arc Creek Reservoir and Sulphur Basin Supplies) and Greater Texoma Utility Authority (desalination). It is an alternative source of supply for North Texas Municipal Water District (desalination), Dallas Water Utilities, and Upper Trinity Regional Water District.

5B.6 Water from Oklahoma

Several wholesale water providers in the Metroplex have been pursuing the purchase of water from Oklahoma. At the present time, the Oklahoma Legislature has established a moratorium on the export of water from the state. Since the 2011 Plan, the Tarrant Regional Water District pursued a case in Federal Court to determine whether this moratorium could be overturned, and the Supreme Court subsequently ruled in favor of Oklahoma. For the long term, Oklahoma remains a potential source of water supply for Region C.

Raw water from Oklahoma would be a relatively inexpensive supply and would have relatively low environmental impacts because of the use of existing sources. Water from Oklahoma is a recommended strategy for North Texas Municipal Water District (50,000 acre-feet per year), with a capital cost of $167.5 million. It is identified as an alternative strategy for the Tarrant Regional Water District (50,000 acre-feet per year) and the Upper Trinity Regional Water District (15,000 acre-feet per year).

5B.7 Tarrant Regional Water District and Dallas Integrated Pipeline

The Tarrant Regional Water District (TRWD) and Dallas Water Utilities (DWU) are cooperating to construct the Integrated Pipeline, which will deliver water to Tarrant and Dallas Counties from Lake Palestine, Cedar Creek Lake, and Richland-Chambers Reservoir. The pipeline will have a capacity of about 350 mgd, with about 200 mgd for TRWD and 150 mgd for Dallas. Dallas's share of the project will deliver water from Lake Palestine and is discussed in Section 5B.12 below. TRWD's share will have the capacity to deliver about 179,000 acre-feet per year from Cedar Creek Lake and Richland-Chambers Lake (assuming a 1.25 peaking factor). The project is a recommended water management strategy for TRWD and DWU, and the capital cost is $1.7 billion.

5B.8 Lower Bois d'Arc Creek Reservoir

The proposed Lower Bois d'Arc Creek Reservoir was a recommended strategy for the North Texas Municipal Water District in the 2001, 2006, and 2011 Region C Water Plans [1,12,13]. The project is located in Region C on Bois d'Arc Creek in Fannin County, northeast of the city of Bonham. It would yield 120,200 acre-feet per year and would provide an inexpensive source of supply for Region C. The project would inundate 17,068 acres. The 1984 Fish and Wildlife Service Texas Bottomland Hardwood Preservation Program [5] report classified the Bois d'Arc Creek bottoms in the reservoir area as Priority 4 bottomland hardwoods, which are "moderate quality bottomlands with minor waterfowl benefits." NTMWD has received a water right permit (including an interbasin transfer permit) and is currently seeking a Federal Section 404 permit for the project. Lower Bois d'Arc Creek Reservoir is a recommended water management strategy for the North Texas Municipal Water District and would have a capital cost of $625.6 million including water transmission facilities.

5B.9 George Parkhouse Lake (North)

George Parkhouse Lake (North) is a potential reservoir located in Region D on the North Sulphur River in Lamar and Delta Counties. It would yield 148,700 acre-feet per year (with 118,960 acre-feet per year available for Region C), but its yield would be reduced substantially by development of Lake Ralph Hall or Marvin Nichols Reservoir. George Parkhouse Lake (North) would provide an inexpensive source of supply for Region C. The project would inundate 15,359 acres. A large portion of the land impacted is cropland or pasture. There are no designated priority bottomland hardwoods located within or adjacent to the site. Development would require a water right permit and an interbasin transfer permit. George Parkhouse Lake (North) is not a recommended water management strategy for any Region C water supplier. It is an alternative strategy for the North Texas Municipal Water District and the Upper Trinity Regional Water District.

5B.10 Lake Palestine

Dallas Water Utilities has a contract with the Upper Neches River Municipal Water Authority for 114,337 acre-feet per year of water from Lake Palestine and an interbasin transfer permit allowing the use of water from the lake in the Trinity River Basin. Based on the firm yield of the reservoir per TCEQ WAM, the available supply to DWU in 2030 is 110,670 acre-feet per year and in 2070 is 106,239 acre-feet per year. Lake Palestine is located in East Texas Region on the Neches River. Dallas Water Utilities plans to connect Lake Palestine to its water supply system as part of the Integrated Pipeline Project being developed jointly with Tarrant Regional Water District. Development of a supply from Lake Palestine provides water at a low cost and with a low environmental impact, and it is a recommended water management strategy for Dallas Water Utilities. The capital cost for the strategy is approximately $900 million, including Dallas' portion of the Integrated Pipeline.

5B.11 Neches River Run-of-the-River Diversion

Lake Fastrill was a recommended water management strategy in the approved *2006 Region C Water Plan* (12) and the 2007 State Water Plan (15) and was designated by the Texas Legislature as a unique site for reservoir development. The lake was intended to meet projected water supply needs for the Dallas and water user groups in Anderson, Cherokee, Henderson, and Smith Counties in Region I. A decision of the United States Supreme Court on February 22, 2010 not to hear the appeals of the State of Texas and Dallas has effectively supported the creation of the Neches River National Wildlife Refuge (NRNWR) and rendered the development of Lake Fastrill not feasible at this time.

In 2013 Dallas and the Upper Neches River Municipal Water Authority (UNRMWA) initiated the Upper Neches River Water Supply Project Feasibility Study to evaluate options to replace the Fastrill Reservoir project. After considering the various strategy scenarios developed during the course of the study, Dallas decided that the preferred Upper Neches Project would include run-of-river diversions of unappropriated streamflow from the Neches River operated conjunctively with system operations with Lake Palestine. It is anticipated that this project will be online by 2060 and will provide 42 MGD (47,250 acre-feet/year) of supply. This is a recommended strategy for Dallas Water Utilities and the estimated capital cost is $227 million.

5B.12 George Parkhouse Lake (South)

George Parkhouse Lake (South) is a potential reservoir located in Region D on the South Sulphur River in Hopkins and Delta Counties. It is located downstream from Jim Chapman Lake and would yield 135,600 acre-feet per year (with 108,480 acre-feet per year available for Region C). Its yield would be reduced substantially by the development of Marvin Nichols Reservoir. George Parkhouse Lake (South) would inundate 28,362 acres. A large portion of the land impacted is cropland or pasture. There are no designated priority bottomland hardwoods located within or adjacent to the site. Development would require a water right permit and an interbasin transfer permit. George Parkhouse Lake (South) is not a recommended water management strategy for any Region C water supplier. It is an alternative strategy for the North Texas Municipal Water District and the Upper Trinity Regional Water District.

5B.13 Tarrant Regional Water District Wetlands Project

The Tarrant Regional Water District has water rights allowing the diversion of return flows of treated wastewater from the Trinity River. TRWD has already developed a reuse project at Richland-Chambers Reservoir. The water is pumped from the Trinity River into the constructed George W. Shannon Wetlands for treatment and then pumped into Richland-Chambers Reservoir. TRWD will be developing an additional similar reuse project at Cedar Creek Reservoir in the near future that will operate in a similar fashion. The available supply for the Cedar Creek reuse project is 88,059 acre-feet per year by 2070. This supply is based on TRWD's water right for this reuse supply.

This is a relatively inexpensive source of new supply for the Tarrant Regional Water District, and the environmental impacts are low. It is a recommended strategy for the Tarrant Regional Water District, and the estimated capital cost to TRWD is $139 million.

5B.14 Carrizo-Wilcox Aquifer Groundwater in Freestone and Anderson Counties (Region I)

The Carrizo-Wilcox aquifer covers a large area of east, central, and south Texas. Organizations (including Forestar) and individuals have been studying the development of water supplies in Freestone and Anderson Counties and surrounding counties for export. Metroplex water suppliers have been approached as possible customers for the water.

Since this is a groundwater supply, no interbasin transfer permit would be required. Carrizo-Wilcox groundwater Freestone/Anderson Counties is an alternative strategy for North Texas Municipal Water District.

5B.15 Carrizo-Wilcox Aquifer Groundwater in Wood, Upshur, and Smith Counties (Regions D and I)

The Carrizo-Wilcox aquifer covers a large area of east, central, and south Texas. In Dallas' recent Long Range Plan, groundwater from the Carrizo-Wilcox aquifer in Wood, Upshur, and Smith Counties was identified as a potential water supply. This is a relatively expensive source of supply for Region C, with delivered raw water costing about $2.06 per thousand gallons until the debt service is paid on the initial construction. Since this is a groundwater supply, no interbasin transfer permit would be required. Carrizo-Wilcox groundwater from Wood, Upshur, and Smith counties in Regions C and I is an alternative strategy for Dallas Water Utilities.

5B.16 Cypress Basin Supplies (Lake O' the Pines)

Lake O' the Pines is an existing Corps of Engineers reservoir, with Texas water rights held by the Northeast Texas Municipal Water District. The lake is on Cypress Creek in the Cypress Basin in Senate Bill One water planning Region D, the North East Texas Region. Some Metroplex water suppliers have explored the possibility of purchasing supplies in excess of local needs from the Cypress Basin for use in the Metroplex. There could be as much as 89,600 acre-feet per year available for export from the basin. Development of this source would require contracts with the Northeast Texas Municipal Water District and other Cypress River Basin suppliers with excess supplies and an interbasin transfer permit. Since this water management strategy obtains water from an existing source, the environmental impacts would be low.

Lake O' the Pines is about 120 miles from the Metroplex, and the distance and limited supply make this a relatively expensive water management strategy. Obtaining water from the Cypress River Basin is not a recommended strategy for any Region C supplier. It is an alternative strategy for North Texas Municipal Water District for an amount of 87,900 acre-feet per year (this is slightly less than the full amount that might be available). The capital cost for this strategy is approximately $362 million.

5B.17 Indirect Reuse Implementation by Dallas

Dallas has rights to the return flow for much its water supply and plans to utilize those return flows through two projects on the Main Stem of the Trinity River. Those projects are the Main Stem Pump

Station and the Main Stem Balancing Reservoir. More detail is provided on these two specific projects in Section 5C.1 under Dallas. The Main Stem Pump Station is anticipated to be online in 2020 and provide 34,751 acre-feet per year of supply. The Main Stem Balancing Reservoir is anticipated to be online in 2050 and provide as much as 114,342 acre-feet per year of supply by 2070.

5B.18 Main Stem Trinity River Pump Station (NTWMD)

The Main Stem Trinity River Pump Station will divert water from the Trinity River for delivery to the North Texas Municipal Water District (NTMWD) East Fork Wetlands. NTMWD is developing an agreement with the Trinity River Authority to purchase to up 50 million gallons per day of return flows from the main stem of the Trinity River that originate from TRA's Central Regional Wastewater System. Initially this pump station will deliver up to 53,135 acre-feet per year, but use of this pump station will diminish over time as more of NTWMD's own return flow is available from their wastewater plants located on the East Fork of the Trinity River. This is a recommended strategy for NTMWD. The capital cost of a 90 MGD pump station that will supply both NTMWD and DWU is approximately $161 million, of which NTMWD's share is $116 million and DWU's share is $44 million.

5B.19 Tehuacana Reservoir

Tehuacana Reservoir is a proposed reservoir on Tehuacana Creek in Freestone County in Region C. It was an alternative strategy for the Tarrant Regional Water District in the 2001, 2006, and 2011 Region C Water Plans [1,12,13]. Tehuacana Reservoir would flood nearly 15,000 acres adjacent to Richland-Chambers Reservoir and would have a yield of 41,600 acre-feet per year. There are no priority bottomland hardwoods within the site. Development of this supply would require a new water right permit, construction of the reservoir, and up-sizing TRWD's third pipeline to deliver that water to Tarrant County. Tehuacana Reservoir is a recommended water management strategy for Tarrant Regional Water District. The capital cost for the strategy is approximately $743 million including the transmission system to Tarrant Regional Water District service area.

5B.20 Lake Ralph Hall and Reuse

In September 2013, Upper Trinity Regional Water District was granted a water right permit for the proposed Lake Ralph Hall, located on the North Fork of the Sulphur River in Fannin County in Region C. The reservoir would flood approximately 8,000 acres. The yield of the project would be 34,050 acre-feet per year, and Upper Trinity Regional Water District plans to apply for the right to reuse return flows from water originating from the project (assumed to be 60%), providing an additional 18,387 acre-feet per year. (Return flows will increase over time and it has been assumed that the full 18,387 acre-feet per year will be available after 2070; 2070 available return flow is estimated at 16,071 acre-feet per year). Developing Lake Ralph Hall and the related reuse is a recommended strategy for the Upper Trinity Regional Water District. The capital cost for the strategy is approximately $316 million.

5B.21 Lake Columbia

The Angelina and Neches River Authority has a Texas water right for the development of the proposed Lake Columbia on Mud Creek in the Neches River Basin in East Texas Region. The Authority is pursuing development of the reservoir and has applied for a Federal 404 permit from the Corps of Engineers. In its most recent long-range planning effort, Dallas Water Utilities studied purchasing 56,050 acre-feet per year from Lake Columbia and delivering the water through Lake Palestine [(10)]. Lake Columbia would flood about 11,500 acres. According to DWU's Long-Range Water Supply Plan, the footprint of Lake Columbia will impact approximately 5,700 acres of potential wetlands and approximately 5,500 acres of potential bottomland hardwoods. Lake Columbia is a recommended water management strategy for Dallas Water Utilities and the project is expected to be online in 2070. The capital cost for this strategy is approximately $327 million including the transmission system for transferring supplies from Lake Columbia to the IPL booster pump station at Lake Palestine.

5B.22 Summary of Recommended Major Water Management Strategies

Table 5B.2 is a summary of the recommended major water management strategies for Region C. The 15 recommended major strategies listed on Table 5B.2 supply a total of 1.6 million acre-feet per year to Region C at a capital cost of $12.3 billion. These projects represent the majority of the total supply from strategies (1.79 million acre-feet per year), and represent about half of the cost of all recommended strategies ($23.6 billion). Much of the remaining cost of strategies is associated with infrastructure projects to treat and deliver this supply to water user groups.

Table 5B.2
Recommended Major Water Management Strategies for Region C

Strategy	Supplier	Supply (Ac-Ft/Yr)	Supplier Capital Cost	Supplier Unit Cost ($/1000 gal.)	
				With Debt Service	After Debt Paid
Toledo Bend Reservoir	NTMWD	100,000	$1,248,461,000	$4.07	$0.95
Sulphur Basin Supplies	NTMWD	174,800	$1,206,634,000	$2.18	$0.51
	TRWD	280,000	$3,004,413,000	$3.47	$0.82
	UTRWD	35,000	$305,499,000	$2.78	$0.65
TRWD Integrated Pipeline	TRWD	179,000[a]	$1,733,914,000	$3.41	$0.42
Lower Bois d'Arc Creek Reservoir	NTMWD	120,200	$625,610,000	$1.55	$0.22
Lake Palestine	DWU	110,670	$900,817,000	$4.68	$2.56
New Lake Texoma (Blend)	NTMWD	97,838	$521,775,000	$3.56	$0.90
TRWD Wetlands	TRWD	88,059	$139,078,000	$1.28	$0.35
Lake Ralph Hall and Reuse	UTRWD	52,437[b]	$316,160,000	$1.79	$0.25
Main Stem Pump Station	DWU	34,751	$44,481,000	$0.47	$0.14
Main Stem Balancing Reservoir	DWU	114,342	$674,463,000	$1.86	$0.54
Main Stem Pump Station	NTMWD	53,088	$71,743,000	$0.47	$0.14
Lake Columbia	DWU	56,050	$327,187,000	$2.80	$1.48
Oklahoma	NTMWD	50,000	$167,541,000	$1.56	$0.70
Neches Run-or-River	DWU	47,250	$226,790,000	$2.14	$0.91
Lake Tehuacana	TRWD	41,600	$742,730,000	$4.24	$0.46
Region C Total[c]		**1,795,148**	**$23,640,306,000**		

Note: The costs and unit costs in Table 5B.2 may be different from those in Table 5B.1 because the amounts and participants may be different.

(a) The TRWD Integrated Pipeline is not a new supply to the region and is not included in the Region C Total supply.

(b) The ultimate project supply is 52,437 ac-ft/yr (including all return flow). The 2070 supply is 50,121 ac-ft/yr (with not all of the return flow being available in 2070).

(c) This is the total in the whole region for all strategies, not the total of strategies in this table.

SECTION 5B
LIST OF REFERENCES

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(15) Texas Water Development Board: Water for Texas 2007. [Online] Available URL: http://www.twdb.state.tx.us/wrpi/swp/swp.htm, April 2006.

5C Recommended Water Management Strategies for Wholesale Water Providers

As discussed in earlier chapters, the Region C Water Planning Group has designated 41 wholesale water providers – 13 classified as regional wholesale water providers and 28 classified as local wholesale water providers. The majority of the water supplied in Region C is provided by the 12 regional wholesale water providers, nine of which are based in the region, with four located in other regions. Collectively, the nine regional wholesale water providers located in Region C (Dallas Water Utilities, Tarrant Regional Water District, North Texas Municipal Water District, Fort Worth, Upper Trinity Regional Water District, Greater Texoma Utility Authority, Trinity River Authority, Corsicana, and Dallas County Park Cities Municipal Utility District) provide over 90 percent of the total water needs in the region. These entities are expected to continue to provide over 90 percent of the water supply for Region C through 2070, and they will also develop most of the new supplies for the region during that time period.

The four regional wholesale water providers located in other regions (Sabine River Authority, Sulphur River Water District, Upper Neches River Municipal Water Authority, and Sulphur River Basin Authority) also play an important role in water supply for Region C. The first three of these providers own and/or operate major sources of current water supply for Region C. The fourth entity (SRBA) is expected to play an important role in future supplies to Region C through their participation in development of supplies in the Sulphur River Basin in conjunction with Region C entities. Recognizing the importance SRBA will have in future water supplies, the Region C Water Planning Group designated SRBA as a Wholesale Water Provider at their September 28, 2015 meeting.

The 28 local wholesale water providers supply considerable quantities of water to water user groups in their areas and are expected to continue meeting these local water needs. Several of the local wholesale providers obtain water exclusively from a regional wholesale provider. It is assumed that these entities will continue to purchase water from the regional provider. Other local water providers will develop new water management strategies to meet their needs and those of their customers.

As part of the preparation of this regional water plan, consultants met with larger WWPs on numerous occasions and conducted individual teleconferences with the remainder of the WWPs. In addition, published plans of these entities were considered in the preparation of this final adopted regional plan.

This section discusses the recommended water supply plans for each regional wholesale water provider (Section 5C.1) and local wholesale water provider (Section 5C.2). Evaluations of specific water management strategies are included in Appendix P, and detailed costs are shown in Appendix Q. Cost estimates for conservation strategies were developed for individual water user groups and are discussed in Chapter 5E and shown in Appendix Q. Detailed listings of demands by customer and the projected need for additional water for each of the wholesale water providers located in Region C are included in Appendix H.

Many of the strategies included in this section are infrastructure projects needed to delivery and/or treat water included in another strategy. Quantities for these infrastructure projects have been shown in *gray italics* so they can be easily identified. To avoid double-counting quantities of supply, the quantities in *gray italics* are not included in the totals for the tables.

Based on TWDB regional planning Guidance, a Management Supply Factor has been listed for each wholesale water provider. This Management Supply Factor, commonly referred to as a safety factor, is calculated as the existing water supply plus supply from strategies, divided by total demand.

In general, the Region C Water Planning Group has adopted strategies that will develop a total supply for wholesale water providers some amount greater than the projected demands. This policy was adopted for several reasons:

- The additional supply provides a margin of safety in case climate change reduces the supply available from existing sources.
- The additional supply provides a margin of safety in case of a drought more severe than the previous drought of record, which would reduce the supply available.
- The additional supply provides a margin of safety in case of unanticipated population growth or industrial growth within the region. This is in response to the November 2014 Drought Preparedness Council recommendation to all regional water planning groups.
- The additional supply provides a margin of safety in case some proposed management strategies cannot be developed or are developed more slowly than anticipated.
- The additional supply provides a margin of safety in case of contamination of sources by invasive species or other contaminate that makes specific supplies unusable for some period of time.

5C.1 Recommended Strategies for Regional Wholesale Water Providers

The recommended strategies for the regional wholesale water providers include conservation, reuse, connections to existing sources already under contract, connections to other existing sources, and the development of new supplies. These strategies are described in greater detail below.

5C.1.1 Strategies for Multiple Wholesale Water Providers

Sulphur Basin Supplies. The Sulphur Basin Supplies strategy is a recommended strategy for the Tarrant Regional Water District (TRWD), the North Texas Municipal Water District (NTMWD) and the Upper Trinity Regional Water District (UTRWD). This strategy consists of a combination of water from the Marvin Nichols Reservoir (313.5 feet, msl) and the reallocation of conservation storage in Wright Patman Lake. In the previous three Region C water plans, Marvin Nichols Reservoir has been a recommended strategy and the reallocation of Wright Patman Lake has been an alternative strategy (2001 *Region C Water Plan* [1], the *2006 Region C Water Plan* [2], and the *2011 Region C Water Plan* [3]).

The Region C entities that are interested in development of Sulphur Basin Supplies (NTMWD, TRWD, Dallas, UTRWD, and Irving), along with the Sulphur River Basin Authority, have formed a Joint Committee on Program Development (JCPD). Since 2001, the JCPD Region C entities have provided more than $5 million to the SRBA to further investigate the development of surface water supplies in the Sulphur River Basin. Ongoing Sulphur Basin Feasibility studies are being conducted by the U.S. Army Corps of Engineers, SRBA and the JCPD. At the direction of SRBA and the JCPD, these ongoing studies are seeking to address concerns from Region D entities regarding the protection of natural resources, environmental impacts, and the socio-economic impacts of developing water supply within Region D and the Sulphur Basin. As a result, these ongoing studies have identified additional options for water supply in the Sulphur Basin that may address concerns from Region D and would also develop supply needed for Region C and Region D entities.

As identified in the 2014 Sulphur River Basin studies [4], this 2016 Region C Water Plan recommends a Marvin Nichols Reservoir that would be part of a combined strategy with the reallocation of flood storage to conservation storage in Wright Patman Lake. (This combination is referred to in this plan as the Sulphur Basin Supplies strategy). The proposed combined Marvin Nichols and Wright Patman strategy would yield around 600,000 acre-feet per year (calculated using TCEQ WAM models, assuming Lake Ralph Hall is senior, and accounting for environmental flows). The Sulphur Basin Supplies strategy is a recommended water management strategy for NTMWD, UTRWD, and TRWD. It is also an alternative strategy for Dallas and the City of Irving. Approximately 80 percent of the water supplied from the Sulphur Basin Supplies strategy is expected to serve customers of wholesale water providers in Region C and approximately 20 percent would serve water needs in Region D.

The division of about 500,000 acre-feet per year assumed to be available to Region C from this recommended Sulphur Basin Supplies strategy is:

- 280,000 acre-feet per year for Tarrant Regional Water District
- 174,000 acre-feet per year for North Texas Municipal Water District
- 35,000 acre-feet per year for Upper Trinity Regional Water District.

The delivery system from Wright Patman and Marvin Nichols (which accounts for three-quarters of the total cost of the project) will be developed in phases. Phase 1 would be developed by 2050 and would include supply from the Wright Patman reallocation portion and the initial pipelines and pump stations. Phase 2, planned for 2070, includes supply from the Marvin Nichols reservoir, parallel pipelines and additional pump stations to deliver the remainder of the supply from the project.

For the purpose of this 2016 plan, the specific combination that is being used for cost estimates and environmental evaluation is the Marvin Nichols at elevation 313.5 feet, msl (inundation of 41,733 acres) and Wright Patman at 232.5 feet, msl (which would inundate an additional 9,429 acres beyond the current conservation pool elevation). This combination of elevations is currently being optimized and recommendations in future Region C Plans will reflect the latest available information of the ongoing studies.

Marvin Nichols Reservoir. Region C is retaining Marvin Nichols Reservoir (at elevation 328 feet, msl) as an alternative water management strategy for the 2016 Region C Water Plan. It is an alternative strategy for NTMWD, UTRWD, TRWD, and Irving. Additional information on this alternative strategy can be found in several locations in this report, specifically in Section 5B.4, Appendix P, and Appendix Y.

Region C recognizes that there are inherent risks and impacts associated with the Sulphur Basin Supplies strategy described above, particularly the reallocation of flood storage at Wright Patman Lake. Reallocation of storage at Wright Patman Lake at the scale envisioned for the Sulphur Basin Supplies strategy will require recommendation by the Corps of Engineers/Department of the Army and approval by the United States Congress. Prior to making a recommendation, the Corps will need to conduct a detailed evaluation of impacts associated with raising the conservation pool elevation. Potentially significant impacts could include inundation of natural resources within the flood pool, loss of flood protection downstream, increased impacts to cultural resources on the reservoir perimeter, effects on the Congressionally-established White Oak Creek Mitigation Area in the upper reaches of the Wright Patman flood pool, and reduced flexibility in International Paper's effluent management operations downstream of the dam. Wright Patman reallocation may also be constrained by Dam Safety considerations. As more detailed studies seek to develop an understanding of the tradeoffs between the environmental impacts at Wright Patman in comparison with the predicted impacts of new storage at the Marvin Nichols site, the risk exists that the Wright Patman reallocation alternative may be constrained by either policy or environmental issues, or both. Should the reallocation of Wright Patman not be achieved, Region C could choose to substitute the alternative Marvin Nichols Reservoir strategy (elevation 328 feet, msl) in place of the Sulphur Basin Supplies recommended strategy.

Toledo Bend Reservoir. The use of water from Toledo Bend Reservoir in East Texas for water supply in North Texas is a recommended strategy for North Texas Municipal Water District in Region C. Toledo Bend Reservoir is an alternative strategy for Tarrant Regional Water District, Dallas Water Utilities, and Upper Trinity Regional Water District. The facilities to deliver the water would be developed in phases, with Phase 1 planned for 2060 and Phase 2 planned after 2070. For the recommended strategy with participation from the NTMWD, the project would include the Phase 1 delivery of 200,000 acre-feet per year of water including:

- 100,000 acre-feet per year for the Sabine River Authority in the upper Sabine Basin (North East Texas Region, Region D)
- 100,000 acre-feet per year for North Texas Municipal Water District.

Oklahoma. Several wholesale water providers in the Metroplex have been pursuing the purchase of water from Oklahoma. At the present time, the Oklahoma Legislature has established a temporary moratorium on the export of water from the state. Since the 2011 Plan, the Tarrant Regional Water District pursued a case in Federal Court to determine whether this moratorium could be overturned, and the Supreme Court subsequently ruled in favor of Oklahoma. For the long term, Oklahoma remains a potential source of water supply for Region C. At this time, water from Oklahoma is a recommended strategy for the North Texas Municipal Water District and an alternative strategy for the Tarrant Regional Water District and the Upper Trinity Regional Water District. (Water from Oklahoma is also an alternative strategy for the City of Irving, which is not a wholesale water provider.). The only recommended project from Oklahoma is planned for 2070 and includes 50,000 acre-feet per year for NTMWD.

5C.1.2 Dallas Water Utilities

Dallas Water Utilities (DWU) provides treated and raw water for most of the demands in Dallas County and for demands in several surrounding counties. The water demands on DWU are projected to increase from about 518,000 acre-feet per year in 2020 to about 803,000 acre-feet per year by 2070. It should be noted that the demand on DWU in 2060 reflects an interim sale of raw water from Lake Palestine to Tarrant Regional Water District (TRWD) for that decade only. This sale is an interim strategy necessitated by TRWD's 2060 shortage caused by the deferral to 2070 of the Marvin Nichols portion of the Sulphur Basin Supplies strategy for TRWD. See Section 5C.1.3 for more information.

The supply currently available to DWU is approximately 497,500 acre-feet per year. DWU's current supply is anticipated to increase as future return flows increase to slightly over 506,000 acre-feet per year by 2070. This supply is based on the safe yield of the Dallas' reservoirs, rather than the firm yield. At the request of Dallas, safe yield has been used for Region C planning. Safe yield for the purpose of Dallas is defined as the water that could have been supplied from a reservoir or reservoir system during a repeat of drought-of-record conditions, leaving a pre-determined amount of supply in reserve at the minimum content (in this case approximately three to nine months of supply). The firm yield available to Dallas, which is not used in this analysis but is required to be reported in the regional plan, is 562,000 acre-feet per year in year 2020.

Based on this current supply and projected demand, DWU will need to develop 20,000 acre-feet per year of additional water supplies by 2020 to meet projected demands and almost 297,000 acre-feet per year of additional water supplies by 2070, and will need supplies in addition to that in order to have a safety factor greater than 1.0.

The City of Dallas recently completed an update to their Long Range Water Supply Plan [5] and the Plan was reviewed and adopted by the Dallas City Council on October 8, 2014. At the direction of Dallas, all of the recommended and alternative water management strategies identified in Dallas' Long Range Plan have been incorporated into this Region C Plan. Descriptions of projects below that are in quotations and italics have been taken directly from Dallas' Draft Long Range Plan without revision. Excerpts from Dallas' Plan are included in Appendix L. In addition, the Long Range Plan evaluated multiple potentially feasible water management strategies which were not selected. Those potentially feasible water management strategies have not been repeated in this Region C Plan because, in the opinion of Dallas, those strategies are no longer potentially feasible. The unit costs of Potentially Feasible Strategies for DWU are shown in Figure 5C.1

The recommended water management strategies for DWU are as follows:

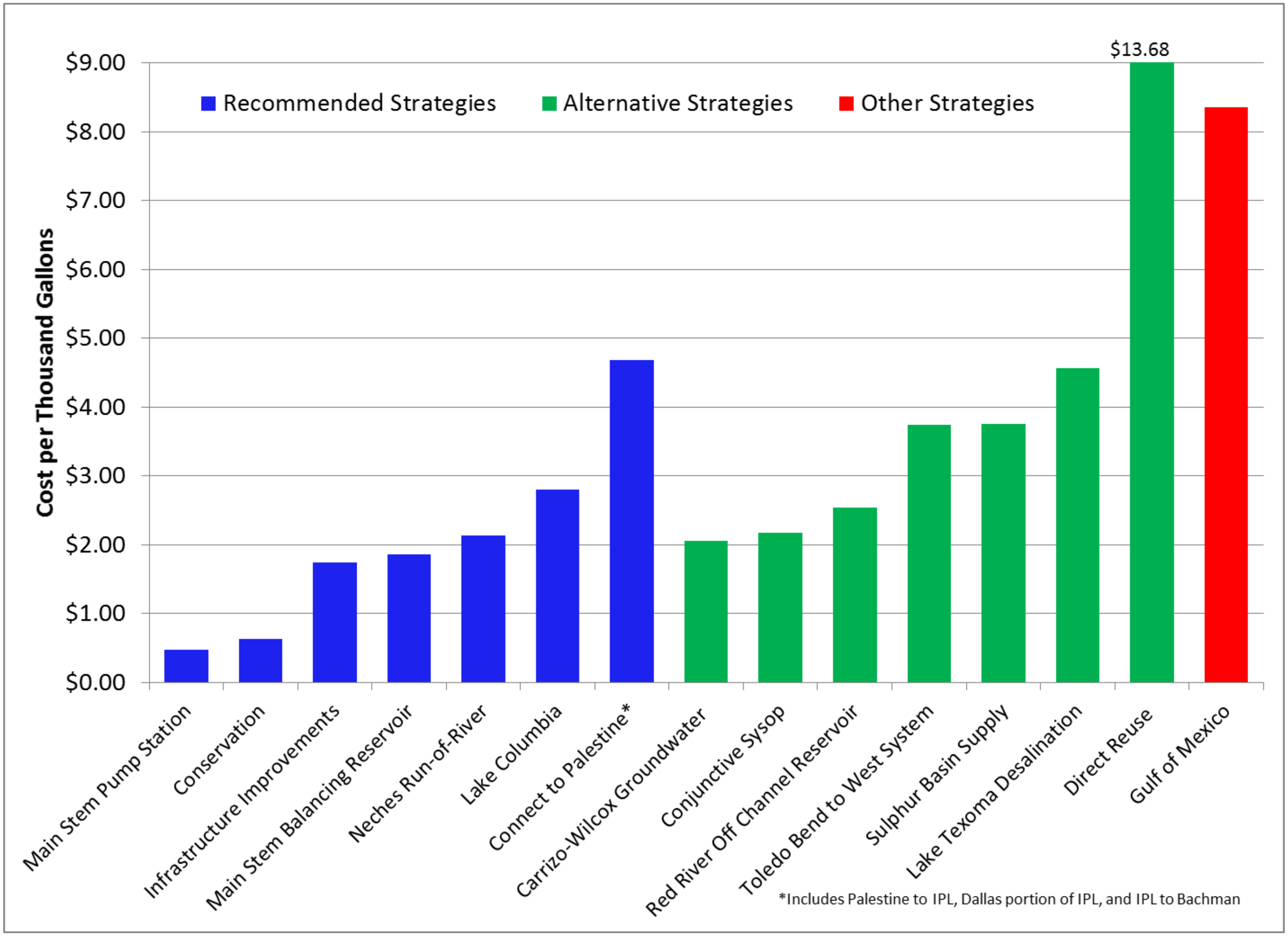
- Conservation
- Indirect Reuse Implementation - Main Stem Pump Station
- Indirect Reuse Implementation - Main Stem Balancing Reservoir
- Connect Lake Palestine (Integrated Pipeline, including connection to Bachman)
- Neches Run-of-River supply
- Lake Columbia
- Infrastructure to Treat and Deliver to Customers

These strategies are discussed individually below.

DWU Conservation. The conservation savings for DWU's retail and wholesale customers are based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures (which are built into the demand projections) and not including reuse, conservation by DWU retail and wholesale customers is projected to reach 55,691 acre-feet per year by 2070.

Indirect Reuse Implementation - Main Stem Pump Station. "*In December 2008, Dallas and the North Texas Municipal Water District (NTMWD) entered into an agreement (swap agreement) for the exchange of return flows. The swap agreement allows Dallas to use NTMWD return flows discharged into Lake Ray Hubbard in exchange for NTMWD utilizing a portion of Dallas' return flows from the main-stem of the Trinity River. Under the swap agreement Dallas and NTMWD will cooperate in the construction of a pump station (Main Stem Pump Station) and transmission pipeline to deliver return flows (from Dallas and other entities) from a location on the main stem of the Trinity River to an agreed "point of delivery" near the NTMWD wetlands located near the East Fork of the Trinity River and Hwy 175 near Seagoville. When the swap agreement is implemented, Dallas will have the right to utilize all NTMWD water discharged into Lake Ray Hubbard. Until the swap agreement is implemented, Dallas has agreed to pass NTMWD's discharges from Lake Ray Hubbard. The project to be constructed under the swap agreement includes the construction of a Main Stem Pump Station and a pipeline to transport water to the NTMWD wetlands*." The amount of supply available from this strategy is 31 MGD (or 34,751 acre-feet per year).

Figure 5C.1
Unit Costs of Potentially Feasible Strategies for DWU



Indirect Reuse Implementation - Main Stem Balancing Reservoir. Dallas' recent Long Range Water Supply Plan identified a 300,000 acre-foot off channel reservoir in Ellis County southeast of Bristol Texas as the Main Stem Balancing Reservoir. "*This site…could store Dallas' (and potentially other entities') return flows as well as stormwater runoff originating in the upstream Trinity River watershed. Additionally, because the diversion location for this strategy is located downstream of the confluence with the East Fork of the Trinity River (East Fork), the Main Stem Balancing Reservoir could also be used to transfer water from Dallas' eastern system to Dallas' western system by storing water released from either Lake Ray Hubbard or from Dallas' eastern raw water transmission pipelines where they cross the East Fork. Dallas has secured water rights to use return flows from their Central and Southside wastewater treatment plants. This reuse water is a valuable asset that can be utilized by Dallas and does not require additional appropriation of state water. The storage of return flows in the balancing reservoir provides several benefits including water quality benefits and the benefit of being able to store the water during times of plenty and diverting it for subsequent use during times of drought….Water supplies will be delivered to the Joe Pool area through a 36.5 mile transmission system*." It is anticipated that this balancing reservoir and delivery system will be online by 2050 and will provide 75 MGD (84,075 acre-feet/year) in 2050 and up to 102 MGD (114,342 acre-feet/year) in 2070.

Connect Lake Palestine. DWU is currently working with Tarrant Regional Water District (TRWD) to develop integrated transmission facilities (Integrated Pipeline, or IPL) to connect Lake Palestine with the DWU system by 2030. DWU has a contract for 114,337 acre-feet per year of water from Lake Palestine. Based on the firm yield of the reservoir per TCEQ WAM, the available supply to DWU in 2070 is 106,239 acre-feet per year. This project consists of a 134 mile long raw water transmission pipeline ranging in diameter from 84-inch to 108-inch. The shared pipeline will convey water at a planned peak capacity of 347 MGD and Dallas' portion of the pipeline is planned to be 150 MGD. Water will be diverted from the IPL, in the Joe Pool Lake area, and be piped directly to the Bachman Water Treatment Plant. Although, other delivery strategies are being evaluated by Dallas.

Neches Run-of-River Supply. Dallas and UNRMWA are long-term partners on Lake Palestine with their initial water sale contract being in place since 1972. "*In 2013 Dallas and the Upper Neches River Municipal Water Authority (UNRMWA) initiated the Upper Neches River Water Supply Project Feasibility Study to evaluate options to replace the Fastrill Reservoir project that was rendered not feasible, at this time, by the establishment of a US Fish & Wildlife Service (USFWS) wildlife refuge in the footprint of the reservoir.*

The study provided technical evaluations of a range of potential water supply strategies for an Upper Neches Project….”

“*The selected Upper Neches Project strategy includes a new river intake and pump station for a run-of-river diversion from the Neches River near the SH 21 crossing. Water would be delivered through a 42-mile, 72-inch diameter pipeline to Dallas' pump station at Lake Palestine for delivery to Dallas through the IPL. Facilities include a small diversion dam on the Neches River, a river intake and pump station, and a transmission pipeline and booster pump station with delivery to the IPL pump station site near Lake Palestine.”* It is anticipated that this project will be online by 2060 and will provide 47,250 acre-feet/year of supply.

Lake Columbia. “*Lake Columbia is a proposed reservoir project (previously known as Lake Eastex) of the Angelina and Neches River Authority (ANRA) and is a recommended strategy in the 2011 East Texas Regional Water Plan (Region I RWP). ANRA has been granted a water right permit (Permit No. 4228) by the TCEQ to impound 195,500 acft in a new reservoir and to divert 76.3 MGD (85,507 acft/yr) for municipal and industrial purposes. ANRA estimates that after considering local needs, approximately 50 MGD of supply would be available to Dallas. The reservoir would be connected to Dallas' western system via a pipeline from Lake Columbia to the proposed IPL pump station at Lake Palestine. Water would then be delivered to the Lake Joe Pool area via the IPL. As currently planned, Dallas' capacity in the IPL is 150 MGD and, after considering Dallas' Lake Palestine supply of 102 MGD, the IPL will initially have available excess capacity of about 48 MGD. Considering the potential for Dallas to manage pumping rates from both Lakes Palestine and Columbia, it is reasonable for Dallas to potentially contract for up to 50 MGD of supply from Lake Columbia. The cost split is subject to future negotiations between Dallas and ANRA. Although for purpose of this study [Dallas Long Range Plan], the assumption was made that Dallas will be responsible for 70 percent of the dam, reservoir land acquisition, and relocations, and the local entities involved in the project will be responsible for the remaining 30 percent of these costs.*” In January 2015 Dallas provided a letter to ANRA outlining Dallas' intent to pursue Lake Columbia as a recommended future strategy. ANRA is currently in the process of obtaining a US Army Corps of Engineers Section 404 permit.

“*The Lake Columbia dam site is located on Mud Creek, approximately three miles downstream of U.S. Highway 79 in Cherokee County, Texas.” The project would include a 20 mile, 42-inch diameter pipeline to the proposed IPL pump station at Lake Palestine. “At the authorized conservation pool capacity of 195,500 acft, Lake Columbia's conservation pool would have a water surface elevation of 315 ft-msl and inundate 10,133 acres with its flood pool affecting an additional 1,367 acres.*"

Infrastructure to Treat and Deliver to Customers. In addition to securing raw water sources, Dallas must also treat the water, and Dallas is responsible for the infrastructure to deliver this treated water to its wholesale customers. Dallas has provided a specific schedule of projects necessary to do this.

Table 5C.1 and Figure 5C.2 show the recommended plan by decade for DWU, and Table 5C.2 presents the costs associated with the recommended strategies.

Figure 5C.3 shows the distribution of DWU's additional 2070 supplies by type (conservation and reuse, connecting existing supplies, and new reservoirs). The estimated capital costs for DWU's recommended water management strategies are shown in Table 5C.2.

In addition, the following alternative water management strategies are designated for DWU in case water demand is higher than projected or one or more of DWU's recommended water management strategies is not developed in a timely manner:

- Additional water conservation
- Direct Reuse
- Carrizo-Wilcox Groundwater
- Sabine Conjunctive System Operation (Off Channel Reservoir and Groundwater)
- Red River Off Channel Reservoir
- Wright Patman and Marvin Nichols Reservoir combined strategy as identified in recent Sulphur River Basin studies [(4)].
- Toledo Bend Reservoir to West System
- Lake Texoma Desalination

Costs for the alternative strategies are shown in Table 5C.3.

Table 5C.1
Summary of Recommended Water Management Strategies for DWU

Planned Supplies (Ac-Ft per Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demands (Table H.6)	**517,643**	**565,386**	**625,183**	**690,751**	**828,677**	**803,244**
Existing						
Elm Fork System	*172,975*	*165,580*	*158,185*	*150,791*	*143,396*	*136,001*
Grapevine Lake	*7,367*	*7,150*	*6,933*	*6,717*	*6,500*	*6,283*
Lake Ray Hubbard	*56,113*	*54,800*	*53,487*	*52,173*	*50,860*	*49,547*
Lake Tawakoni	*174,080*	*169,120*	*164,160*	*159,200*	*154,240*	*149,280*
Lake Fork	*50,120*	*55,080*	*60,040*	*65,000*	*69,960*	*74,920*
Direct Reuse (Golf courses)	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*	*1,121*

Planned Supplies (Ac-Ft per Yr)	2020	2030	2040	2050	2060	2070
White Rock Lake (Irrigation Only)	*3,200*	*2,900*	*2,600*	*2,300*	*2,000*	*1,700*
*Return Flow**	*32,550*	*38,223*	*41,048*	*55,000*	*73,091*	*87,511*
Total Available Supplies	***497,526***	***493,974***	***487,574***	***492,302***	***501,168***	***506,363***
Need (Demand-Supply)	***20,117***	***71,412***	***137,609***	***198,449***	***327,509***	***296,881***
Water Management Strategies						
Conservation (retail)	10,817	26,096	37,456	41,876	42,607	42,020
Conservation (wholesale)	2,876	5,865	7,348	9,335	11,488	13,671
Indirect Reuse Implementation						
Main Stem Pump Station	34,751	34,751	34,751	34,751	34,751	34,751
Main Stem Balancing Reservoir (Reuse)				84,075	102,011	114,342
Connect Lake Palestine (Palestine to IPL to Bachman)		110,670	109,563	108,455	107,347	106,239
Neches Run-of-River					47,250	47,250
Lake Columbia						56,050
*Infrastructure to Treat and Deliver to Customers***	*34,751*	*145,421*	*144,314*	*227,281*	*291,359*	*358,632*
Total Supplies from Strategies	**48,444**	**177,382**	**189,118**	**278,492**	**345,454**	**414,323**
Total Supplies	**545,970**	**671,356**	**676,692**	**770,794**	**846,622**	**920,686**
Reserve or (Shortage)	**28,327**	**105,970**	**51,509**	**80,043**	**17,945**	**117,442**
Management Supply Factor	**1.05**	**1.19**	**1.08**	**1.12**	**1.02**	**1.15**

Notes: * Includes return flows from Flower Mound, Lewisville, Denton, NTMWD and UTRWD.
** This infrastructure is needed to use the supplies developed by other strategies, but they do not develop additional supplies.

Figure 5C.2
Recommended Water Management Strategies for Dallas Water Utilities

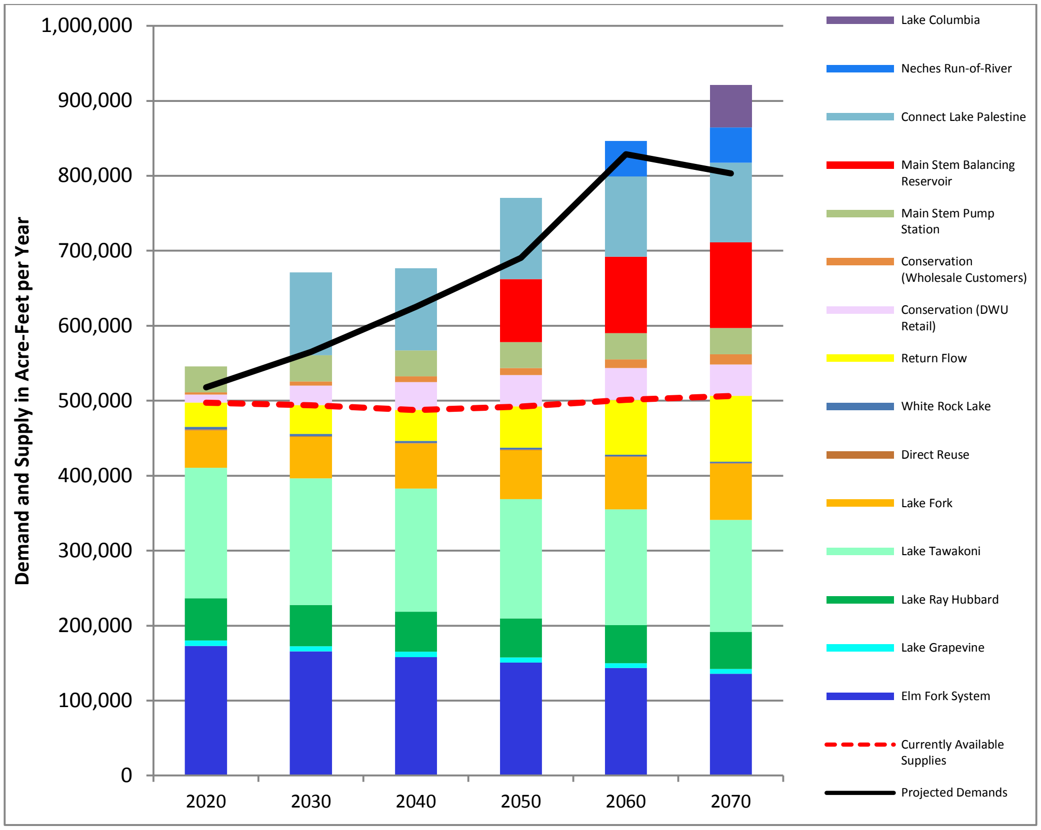


Figure 5C.3
Dallas Water Utilities' 2070 Additional Supply by Type (Acre-Feet per Year)

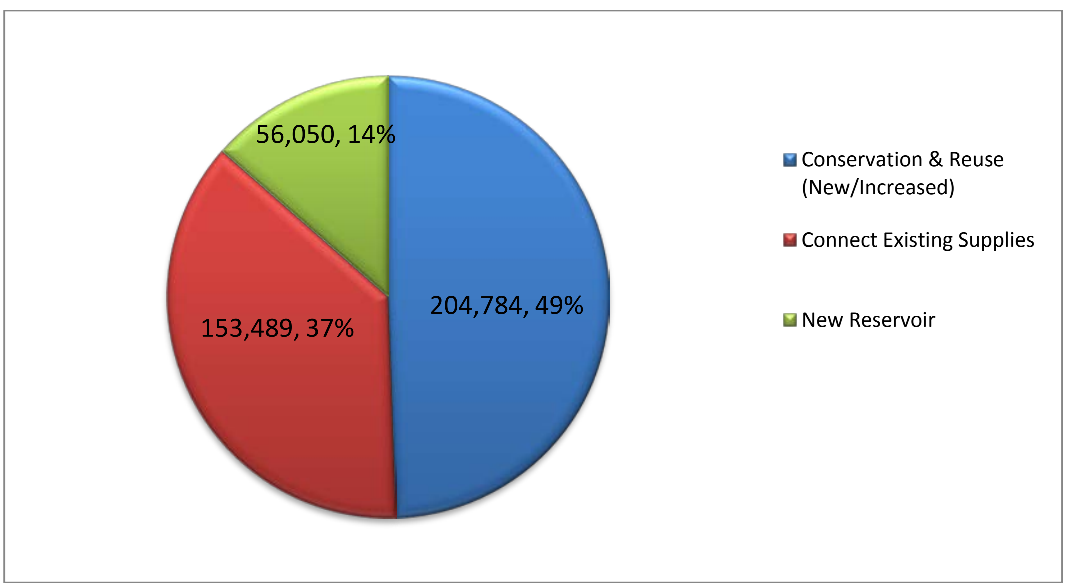


Table 5C.2
Summary of Costs for DWU Recommended Strategies

Strategy	Date to Be Developed	Quantity for DWU (Ac-Ft/Yr)	DWU Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	42,607	$3,124,457	$0.63	$0.46	Q-10
Conservation (wholesale)	2020	13,671	Included under County Summaries in Section5D.			
Indirect Reuse implementation						
Main Stem Pump Station	2020	34,751	$44,481,000	$0.47	$0.14	Q-34
Main Stem Balancing Reservoir (Reuse)	2050	114,342	$674,463,000	$1.86	$0.54	Q-35
Connect Lake Palestine (Palestine to IPL, Dallas Portion of IPL, IPL to Bachman)	2030	110,670	$900,817,000	$4.68	$2.56	Q-36, Q-37, & Q-48
Neches Run-of-River	2060	47,250	$226,790,000	$2.14	$0.91	Q-38
Lake Columbia	2070	56,050	$327,187,000	$2.80	$1.48	Q-39
*Infrastructure to Treat & Deliver to Customers**	2020	*358,632*	$2,087,784,000	$1.75	$0.25	Q-40
Total DWU Capital Costs			**$4,264,646,457**			

* This infrastructure is needed to use the supplies developed by other strategies, but they do not develop additional supplies.

Table 5C.3
Summary of Costs for DWU Alternative Strategies

Strategy	Quantity for DWU (Ac-Ft/Yr)	DWU Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
			With Debt Service	After Debt Service	
Additional Conservation	Unknown	Unknown	Unknown	Unknown	N/A
Direct Reuse Alternative 1	2,242	$95,081,000	$13.68	$2.79	Q-41
Carrizo-Wilcox Groundwater 2	30,267	$161,063,000	$2.06	$0.69	Q-42
Sabine Conjunctive SysOp (Off Channel Reservoir and Groundwater)	104,253	$795,815,000	$2.17	$0.69	Q-43
Red River Off Channel Reservoir 1	114,342	$852,987,000	$2.53	$0.73	Q-44
Sulphur Basin Supplies	114,342	$1,112,715,000	$3.75	$0.83	Q-17
Toledo Bend to West System	200,659	$2,290,065,000	$3.73	$0.80	Q-45
Lake Texoma Desalination	146,000	$1,517,474,000	$4.57	$1.91	Q-46

5C.1.3 Tarrant Regional Water District

Tarrant Regional Water District (TRWD) owns and operates a system of reservoirs and a reuse facility in the Trinity River Basin. Since the last regional plan was published, TRWD has almost completed their portion of the Integrated Pipeline Project (IPL), which is a joint pipeline with the City of Dallas, to deliver additional supplies from east Texas reservoirs. The IPL will greatly increase TRWD's transmission capacity, bringing additional supplies and reuse from Richland-Chambers and Cedar Creek Reservoirs. The IPL is expected to be completed well before 2020, but after the Region C timeframe to be considered as "existing" supply. So for the purposes of this plan it is still considered a Water Management Strategy.

The TRWD system provides water either directly or indirectly to over a hundred water user groups and is expected to provide water to additional water user groups in the future. For the purpose of the 2016 Region C Water Plan, the projected 2020 demand on TRWD is about 518,000 acre-feet per year, increasing to 949,000 acre-feet per year by 2070.

The total supply currently available from the TRWD system accounting for delivery infrastructure limits is about 485,000 acre-feet per year in 2020, including 423,000 acre-feet per year from reservoirs and 62,000 acre-feet per year of reuse. This supply is estimated to be about 489,000 acre-feet per year by 2070. This supply is based on the safe yield of the TRWD reservoirs, rather than the firm yield. TRWD operates its raw water system in accordance with its Management Plan, which is based on the safe yield of the system. Safe yield is defined as the water that could have been supplied from a reservoir or reservoir system during a repeat of drought-of-record conditions, leaving some amount (in this case, one year's supply) in reserve at the minimum content. The firm yield available to TRWD, which is not used in this analysis but is required to be reported in the regional plan, is 588,000 acre-feet per year in year 2020, including 525,000 acre-feet per year from reservoirs and 63,000 acre-feet per year of reuse.

In 2020, TRWD has a projected need for about 33,000 acre-feet per year of new supplies, increasing to about 460,000 acre-feet per year by 2070. TRWD will need to develop other supplies over time to meet their future demands. Nine infrastructure projects were evaluated for TRWD, and the unit costs for these are shown on Figure 5C.4. The full evaluations are summarized in Appendix P. The recommended water management strategies for TRWD are as follows:

- Water Conservation
- Integrated Pipeline (to deliver additional supplies from East Texas Reservoirs and reuse projects)
- Wetland Project for Reuse at Cedar Creek Reservoir
- Lake Tehuacana

- Sulphur Basin Supplies
- Interim Purchase of raw water from Dallas Water Utilities in 2060.

The development of the Sulphur Basin Supplies is a multi-provider strategy and is discussed in Section 5B.3 of this report. The other recommended strategies are discussed individually below.

Conservation. Conservation for TRWD is the projected water savings from the Region C recommended water conservation program for TRWD's existing and potential customers. Not including savings from low-flow plumbing fixtures (which amount to about 10 percent of demand and are built into the demand projections) and not including reuse, conservation by TRWD customers is projected to reach 39,011 acre-feet per year by 2070.

Integrated Pipeline. As mentioned above, the Integrated Pipeline Project (IPL) is a joint pipeline with the City of Dallas which will deliver additional TRWD supplies from east Texas reservoirs. This supply includes the portions of the yield from Cedar Creek Lake and Richland-Chambers reuse project that are currently not available due to delivery constraints. This pipeline will also have capacity to deliver the new supply created by the reuse wetlands project at Cedar Creek Reservoir described below.

Wetland Project for Reuse at Cedar Creek Reservoir. TRWD has water rights allowing the diversion of return flows of treated wastewater from the Trinity River. TRWD has already developed a reuse project at Richland-Chambers Reservoir, and a portion of the supply from this project is included in the currently available supply. The water is pumped from the Trinity River into the constructed George W. Shannon Wetlands for treatment and then pumped into Richland-Chambers Reservoir. TRWD will be developing an additional similar reuse project at Cedar Creek Reservoir in the near future. In November 2014, TRWD's certificates of adjudication for these reuse projects were amended to increase the total permitted reuse diversion to 188,524 acre-feet per year, including 100,465 acre-feet per year at Richland-Chambers and 88,059 acre- feet per year at Cedar Creek Reservoir. The available supply for the Cedar Creek reuse project as calculated by Region C is 88,059 acre-feet per year by 2070.

Lake Tehuacana. Lake Tehuacana is a proposed water supply project on Tehuacana Creek in Freestone County within the Trinity River Basin. Tehuacana Creek is a tributary of the Trinity River and lies immediately south of and adjacent to Richland Creek on which the existing Richland-Chambers Reservoir is located. Tehuacana Reservoir will connect to Richland-Chambers Reservoir by a 9,000-foot channel and be operated as an integrated extension of that reservoir. The project will inundate approximately 15,000 acres. The existing spillway for Richland-Chambers Reservoir was designed to provide enough discharge capacity to accommodate the increased flood flows from Tehuacana Reservoir for the probable maximum flood event. Therefore, the dam for Tehuacana Reservoir can be constructed without a spillway and can function as merely an extension of Richland-Chambers Reservoir. Developing this site will require obtaining a new water right and constructing the dam and reservoir. The additional safe yield created by the construction of Lake Tehuacana is estimated to be 41,600 acre-feet per year. This yield analysis was performed using the new SB3 Environmental Flow requirements. Previous yield analyses were based on the Consensus Criteria for Environmental Flows.

Interim Purchase of raw water from Dallas Water Utilities in 2060. After the 2016 Initially Prepared Plans were published, Region D raised an objection to the Marvin Nichols portion of the Sulphur Basin Supplies strategy that was included in the 2016 Region C Initially Prepared Plan. Section 10.6 of this report provides more detail on this interregional conflict and the resulting mediation agreement. Based on the mediation agreement, the Marvin Nichols portion of the Sulphur Basin Supplies strategy has been modified to begin in 2070 rather than in 2050 (as it was presented in the IPP). The Wright Patman portion of the Sulphur Basin Supplies strategy is still shown beginning in 2050. Deferring the Marvin Nichols portion to begin in 2070 created a shortage for TRWD in 2060. For the purpose of this 2016 Region C Water Plan, an interim purchase of raw water from Dallas Water Utilities in 2060 only is being shown to meet that 2060 shortage. It is assumed that this raw water will originate from Dallas' Lake Palestine supply and will be transported through the Integrated Pipeline. It is assumed that TRWD will operate their system of reservoirs and their portion of the Integrated Pipeline such that no additional capacity (and therefore no additional capital cost) will be needed to transport this additional supply from Lake Palestine.

In addition to these water management strategies for additional supply, TRWD is considering water right amendments to allow greater system operation, with resulting savings in pumping cost and electricity. Improved system operation for TRWD is consistent with the Region C Water Plan.

Table 5C.4 and Figure 5C.5 show the recommended plan for TRWD by decade. Figure 5C.6 shows the distribution of TRWD's new supplies by strategy type. A summary of costs for the recommended strategies is presented in Table 5C.5. TRWD's share of the total capital cost for the recommended plan is $5.62 billion.

The alternative water management strategies for TRWD are as follows:

- Toledo Bend Reservoir
- Western Oklahoma
- Marvin Nichols Reservoir (328 msl).

Costs for the alternative strategies are presented in Table 5C.6.

Table 5C.4
Summary of Recommended Water Management Strategies for TRWD

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Demands (Table H.29)	**518,015**	**586,651**	**660,101**	**743,607**	**835,727**	**949,632**
Existing Supplies						
West Fork System	96,458	95,625	94,792	93,958	93,125	92,292
Benbrook Lake	5,417	5,400	5,383	5,367	5,350	5,333
Lake Arlington	7,667	7,550	7,433	7,317	7,200	7,083
Cedar Creek Lake	126,731	127,267	128,018	129,208	131,932	135,885
Richland-Chambers Reservoir	186,600	182,700	178,800	174,900	171,000	167,100
Richland-Chambers Reuse	61,831	65,731	69,631	73,531	77,431	81,331
Total Available Supplies	***484,704***	***484,273***	***484,057***	***484,281***	***486,038***	***489,024***
Need (Demand - Supply)	***33,311***	***102,377***	***176,044***	***259,326***	***349,689***	***460,608***
Water Management Strategies						
Conservation (Wholesale Customers)	30,236	38,345	31,129	33,393	36,234	39,011
Integrated Pipeline						
Add’l Cedar Creek Lake	32,636	30,583	28,315	25,609	21,368	15,898
Add'l Richland-Chambers Reuse	38,634	34,734	30,834	26,934	23,034	19,134
Cedar Creek Reuse		37,163	63,204	82,860	88,059	88,059
Tehuacana			41,600	41,600	41,600	41,600
Sulphur Basin Supplies				72,670	72,670	280,000
Interim Purchase from DWU					71,300	
Supplies from Strategies	**101,506**	**140,824**	**195,082**	**283,066**	**354,265**	**483,702**
Total Supplies	**586,210**	**625,098**	**679,139**	**767,347**	**840,303**	**972,726**
Reserve or (Shortage)	**68,196**	**38,447**	**19,039**	**23,740**	**4,576**	**23,094**
Management Supply Factor	**1.13**	**1.07**	**1.03**	**1.03**	**1.01**	**1.02**

Figure 5C.4
Unit Costs of Potentially Feasible Strategies for TRWD

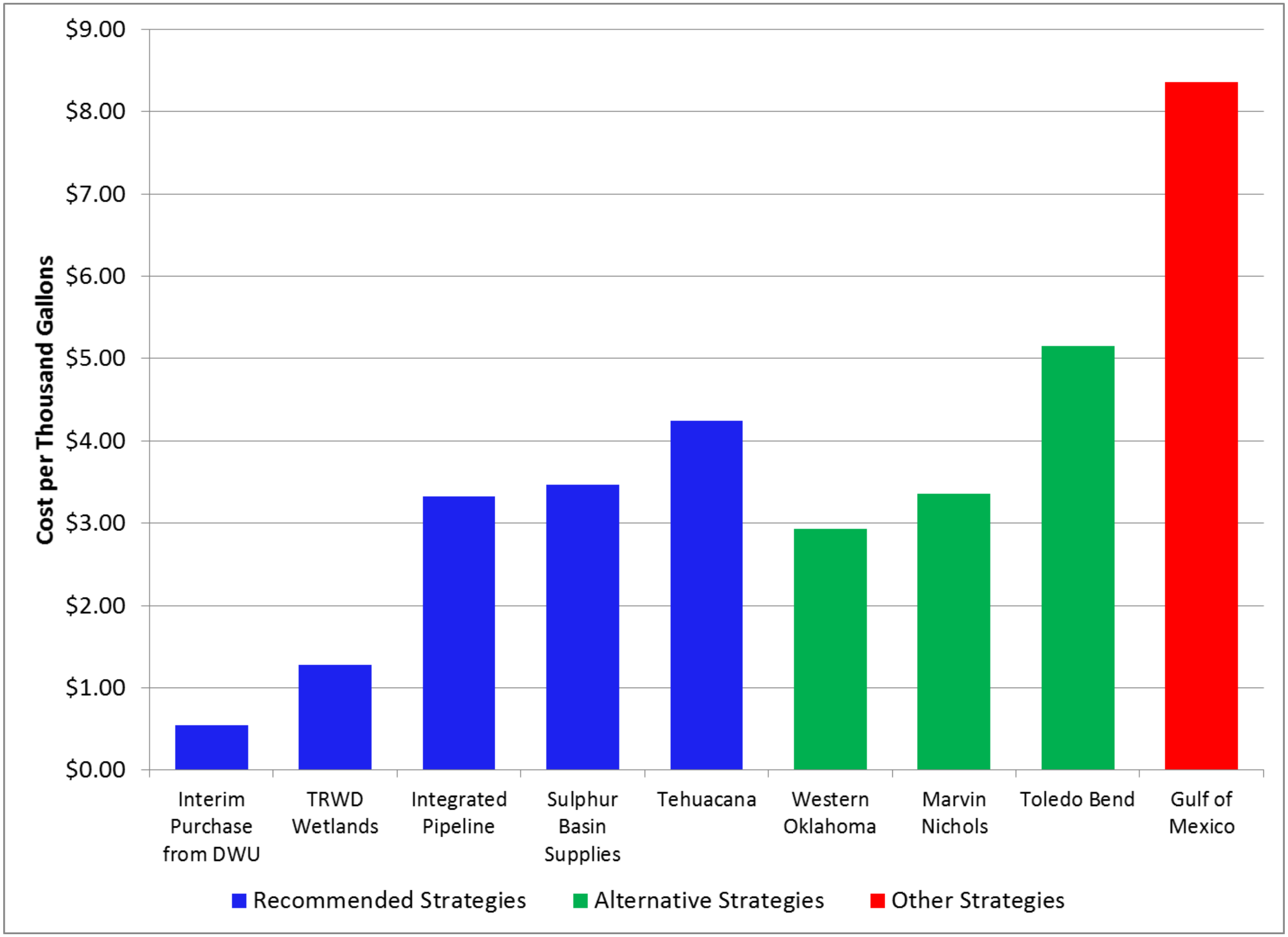


Figure 5C.5
Recommended Water Management Strategies for Tarrant Regional Water District

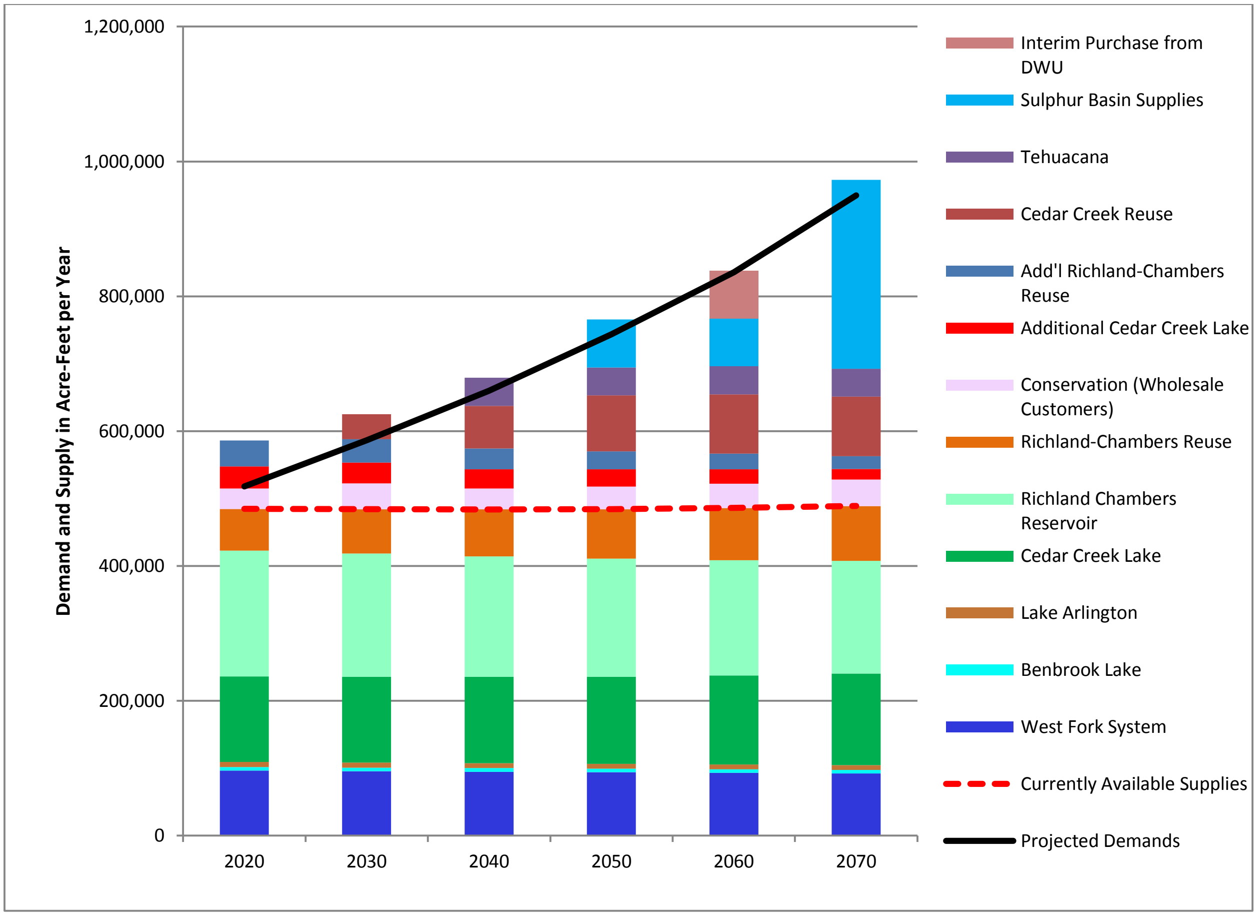


Figure 5C.6
Tarrant Regional Water District's 2070 Additional Supply by Type (Acre-Feet per Year)

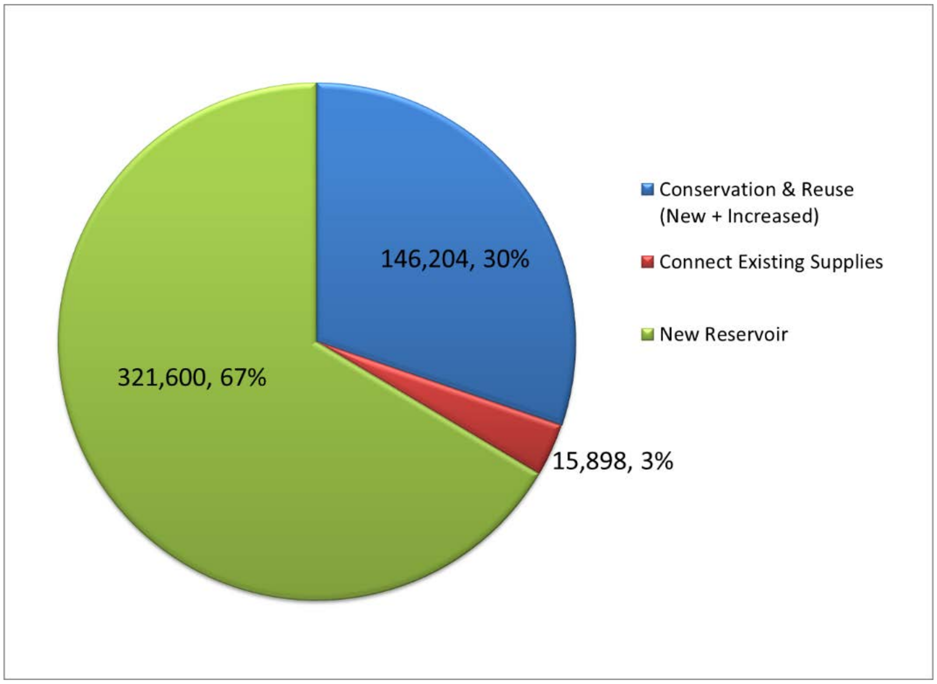


Table 5C.5
Summary of Costs for TRWD Recommended Strategies

Strategy	Date to be Developed	Quantity for TRWD (Ac-Ft/Yr)	TRWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation	2020	39,011	Included under County Summaries in Section 5D.			
Integrated Pipeline	2020	*159,329*	$1,733,914,000	$3.33	$0.73	Q-48
Add'l Cedar Creek Lake	2020	32,636	Included in cost for Integrated Pipeline			
Add'l Richland-Chambers Reuse	2020	38,634				
Cedar Creek Reuse	2030	88,059	$139,078,000	$1.28	$0.35	Q-49
Tehuacana	2040	41,600	$742,730,000	$4.24	$0.46	Q-50
Sulphur Basin Supply	2050	280,000	$3,004,413,000	$3.47	$0.82	Q-18
Interim Purchase from DWU	2060	71,300	$0	$0.54	$0.54	None
Total TRWD Capital Costs			**$5,620,135,000**			

Table 5C.6
Summary of Costs for TRWD Alternative Strategies

Strategy	Quantity for TRWD (Ac-Ft/Yr)	TRWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
			With Debt Service	After Debt Service	
Toledo Bend	200,000	$3,175,290,000	$5.15	$1.06	Q-15
Western Oklahoma	50,000	$424,116,000	$2.93	$0.75	Q-51
Marvin Nichols Reservoir	268,700	$2,778,879,000	$3.36	$0.85	Q-16

5C.1.4 North Texas Municipal Water District

The North Texas Municipal Water District (NTMWD) serves much of the rapidly growing suburban area north and east of Dallas, supplying water to over 75 cities and water suppliers including the cities of Plano, Allen, McKinney, Garland, and Mesquite. The population served by NTWMD is expected to more than double over the next 50 years, growing from about 1.75 million people in 2020 to 3.7 million in 2070. While the population will grow more than 110%, demands on the NTMWD are only expected to increase by 85% from 2020 to 2070. It should be noted that the demands on NTWMD shown in this plan are about 20 to 25% less than the demands presented in 2011 Region C Water Plan. The demands in this plan reflect a large amount of conservation that has been achieved in the past 10 years. Even with these lower demands, NTMWD will still need almost 320,000 acre-feet per year of additional supplies by 2070, and will need supplies in addition to that in order to have a safety factor greater than 1.0. The potentially feasible strategies considered for NTMWD and their unit costs are shown on Figure 4E.7. The recommended water management strategies for NTMWD include:

- Conservation
- Removal of Silt Barrier to Chapman Lake Intake Pump Station
- Dredge Lake Lavon
- Additional Measure to Access Full Yield of Lake Lavon
- Chapman Booster Pump Station
- Main Stem Pump Station & Reuse
- Lower Bois d'Arc Creek Reservoir
- Additional Lake Texoma Supplies (blending with Lower Bois d'Arc water)
- Sulphur Basin Supplies
- Additional Lake Texoma Supplies (blending with Sulphur Basin Supplies)
- Toledo Bend Reservoir

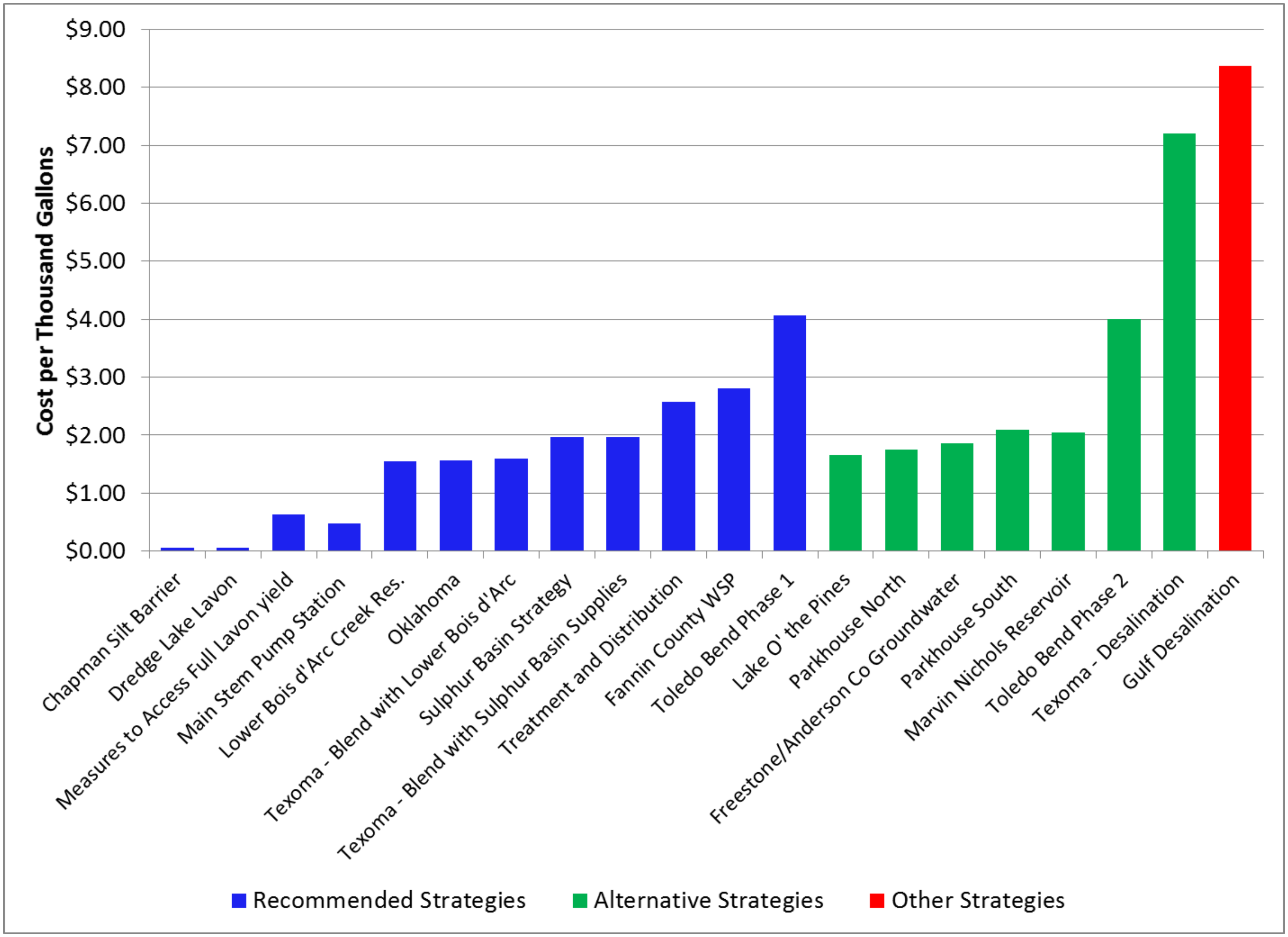
- Oklahoma Water
- Infrastructure to Treat and Deliver to Customers
- Fannin County Water Supply System
- Treatment and Distribution Improvements

The development of the Sulphur Basin Supplies strategy, connection to Toledo Bend Reservoir, and connection to Oklahoma water sources are multi-provider strategies and are discussed earlier in this chapter and in Chapter 5B. The other recommended strategies are discussed individually below.

NTMWD Conservation. Conservation is the projected conservation savings for NTMWD's existing and potential customers, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures (which are built into the demand projections) and not including reuse, conservation by NTMWD customers is projected to reach 25,933 acre-feet per year by 2070.

Removal of Silt Barrier at Chapman Lake Intake Pump Station. NTMWD is in the design phase of a project that would remove a silt barrier in Chapman Lake. This silt barrier currently limits the amount of water reaching the intake structure at the lake. This project will allow for use of full yield of Chapman Lake. This project is estimated to be completed before 2020.

Figure 5C.7
Unit Costs of Potentially Feasible Strategies for NTMWD



Dredge Lake Lavon. NTMWD is in the design phase of a project that will remove sediment in Lake Lavon. This dredging project would allow NTWMD to divert water down to elevation 467 msl. This project is estimated to be completed before 2020.

Additional Measures to Access Full Yield of Lake Lavon. If necessary in drought conditions, NTWMD will take emergency measures to access water below elevation 467 msl. These measures may include, but are not limited to: extension and/or dredging of the pump station intake channel and utilizing floating barges equipped with pumps. The cost estimate for this strategy includes floating barges outfitted with pumps and associated piping, but any emergency measures deemed necessary at the time will be considered to be consistent with this plan.

Main Stem Pump Station and Reuse. NTMWD is currently designing a pump station to deliver water from the Main Stem of the Trinity River to the NTMWD East Fork Wetlands. The capacity of the wetlands is a little over 100,000 acre-feet per year, but current return flows available for reuse from the East Fork are less than half that amount, leaving capacity in the wetlands to treat additional return flows from other sources. NTWMD is developing an agreement with the Trinity River Authority to purchase up to 56,050 acre-feet per year of return flows from the main stem of the Trinity River. This Main Stem pump station will be used to deliver these return flows from the main stem of the Trinity River into the NTMWD East Fork wetlands system. Initially this Pump Station will deliver over 50,000 acre-feet per year, but use of this Pump Station will diminish over time as more return flow is available from the East Fork. In addition, as described under DWU's strategies on page 5C.7, the Main Stem Pump Station will make it possible for Dallas to make use of NTMWD's return flows to Lake Ray Hubbard in return for providing NTMWD with Dallas return flows via the Main Stem Pump Station.

Lower Bois d'Arc Creek Reservoir. Lower Bois d'Arc Creek Reservoir is a proposed reservoir on Bois d'Arc Creek in the Red River Basin. It was included in the 2001, 2006, and 2011 Region C Water Plans [1, 2, 3] as a supply for NTMWD. NTMWD is in the process of obtaining a Texas water right, a Section 404 permit, and other necessary permits for the project. Lower Bois d'Arc Creek Reservoir will provide up to 120,200 acre-feet per year for NTMWD and Fannin County. Lower Bois d'Arc Creek Reservoir will be developed by 2020. The supply shown for the lake in 2020 is limited to 15 MGD due to the anticipation that the lake will still be filling at that time. It is assumed that full filling will occur before 2030. The cost estimate for Lower Bois d'Arc Creek Reservoir includes not only the dam and reservoir, but also transmission facilities to deliver raw water to the proposed Leonard water treatment plant and to deliver treated water to District customers. The cost estimate for the Leonard treatment plant itself is included under NTWMD's strategy of "Treatment and Distribution Improvements."

Additional Supply from Lake Texoma (blending with Lower Bois d'Arc Creek and Sulphur Basin Supplies). NTMWD holds a Texas water right in Lake Texoma to divert and use up to 197,000 acre-feet per year from the lake. Water from Lake Texoma is high in dissolved solids and the current supply from the lake is limited to 84,075 acre-feet per year (75 MGD) by the need to blend Texoma water with other supplies to maintain acceptable water quality. In 2009, the presence of invasive zebra mussels in Lake Texoma prohibited NTMWD from pumping Texoma water into the Trinity River basin via open channel flow or into Lake Lavon, causing NTWMD to lose access to 25% of their then-current supply. In response to this emergency condition, NTWMD completed a 48-mile pipeline from the end of the existing Texoma pipeline directly to NTMWD's four existing water treatment plants located at Lake Lavon.

Since the current maximum use from Texoma is only 84,075 acre-feet per year, this leaves almost 113,000 acre-feet per year that can be used if additional transmission capacity is developed. NTMWD will either blend the water with higher quality supplies from other sources or develop a desalination plant. At this time, blending appears to be the more economical approach. It is assumed that NTMWD will use one part of Lake Texoma supply to three parts of other imported water (specifically water from Lower Bois d'Arc Creek Reservoir and the Sulphur Basin Supplies as they are developed). NTMWD will deliver the water directly from Lake Texoma and/or from the Red River downstream of the lake. (Downstream diversions would require a longer pipeline but offer the advantage of reduced levels of dissolved solids.) It is anticipated that transmission capacity will be constructed in 2040 to deliver about 40,000 acre-feet per year of Lake Texoma supply to be blended with Lower Bois d'Arc water. It is anticipated that additional transmission capacity will be constructed in 2060 to deliver additional Lake Texoma supply to be blended with Sulphur Basin Supplies.

Infrastructure to Treat and Deliver to Customers:

Fannin County Water Supply System. NTMWD will cooperate with Fannin County entities to develop a treated water supply system for Fannin County water users after the Lower Bois d'Arc Creek Reservoir is developed by 2020.

Treatment and Distribution Improvements. In addition to securing raw water sources, NTWMD must also treat the water, and all infrastructure to deliver this treated water to its member cities is the responsibility of NTWMD. NTWMD has a schedule of projects necessary to do this. These projects are divided into decadal needs.

As shown on Table 5C.7 and Figure 5C.8, about 580,000 acre-feet per year of new supplies are recommended for NTMWD, leading to a total supply of about 960,000 acre-feet per year in 2070. Almost 200,000 acre-feet per year of NTMWD's 2070 total water supply will be from conservation and reuse, representing 21 percent of NTMWD's total supplies. Figure 5C.9 shows the new supplies for NTMWD in 2070 by the type of supply. A summary of costs for the recommended strategies is presented in Table 5C.8.

The following alternative water management strategies are recommended for NTMWD:

- Toledo Bend Reservoir Phase 2 (accelerated to occur before 2070)
- Lake O' the Pines
- Lake Texoma with desalination rather than blending
- Groundwater in Freestone/Anderson County Area (Forestar)
- George Parkhouse Reservoir (North)
- George Parkhouse Reservoir (South)
- Marvin Nichols Reservoir (328 msl)

Costs for the alternative strategies are shown in Table 5C.9.

Table 5C.7
Summary of Recommended Water Management Strategies for NTMWD

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (including losses for Treatment & Delivery) (Table H.23)	**379,792**	**437,185**	**505,223**	**573,182**	**637,354**	**699,519**
Existing						
Lake Lavon	*86,500*	*85,900*	*85,300*	*84,700*	*84,100*	*83,500*
Lake Texoma	*70,623*	*70,623*	*70,623*	*70,623*	*70,623*	*70,623*
Chapman Lake	*41,172*	*40,982*	*40,792*	*40,602*	*40,412*	*40,222*
Wilson Creek Reuse	*47,418*	*56,386*	*63,785*	*71,882*	*71,882*	*71,882*
Lake Bonham	*2,511*	*3,195*	*3,195*	*3,195*	*3,195*	*3,195*
East Fork Reuse (with Ray Hubbard Pass through)	*47,802*	*62,977*	*75,524*	*87,291*	*97,655*	*100,890*
Upper Sabine Basin	50,707	10,629	10,550	10,472	10,394	10,315
Direct Reuse for Irrigation (Collin & Rockwall Co)	2,519	2,519	2,519	2,519	2,519	2,519
Total Available Supplies	***349,252***	***333,211***	***352,288***	***371,284***	***380,780***	***383,146***
Need (Demand-Supply)	***30,540***	***103,975***	***152,935***	***201,898***	***256,574***	***316,373***

Planned Supplies (Ac-Ft/Yr) **Water Management Strategies**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Conservation (Wholesale Customers)	8,044	12,805	15,816	18,955	22,305	25,933
Removal of Chapman Silt Barrier	3,620	3,523	3,426	3,329	3,232	3,135
Dredge Lake Lavon	7,959	7,735	7,399	7,062	6,726	6,390
Add'l measure to access full Lavon yield	14,461	13,505	12,661	11,818	10,974	10,130
Chapman Booster Pump Station						
Main Stem PS (additional East Fork wetlands) – TRA sources	53,088	37,913	25,366	13,599	3,235	0
Lower Bois d'Arc Creek Res.	16,815	120,200	120,200	118,000	115,800	113,600
Additional Lake Texoma - Blend with Lower Bois d'Arc water			39,571	39,333	38,600	37,867
Sulphur Basin Supplies					45,367	174,800
Additional Lake Texoma - Blend with Sulphur Basin Supplies					15,122	58,267
Toledo Bend Phase 1					100,000	100,000
Oklahoma						50,000
Infrastructure to Treat & Deliver to Customers:						
Fannin Co. Water Supply System	*56*	*912*	*2,436*	*4,666*	*8,466*	*12,760*
Treatment and Distribution (CIP)	*95,943*	*182,876*	*208,623*	*193,141*	*339,056*	*554,189*
Total Supplies from Strategies	**103,987**	**195,681**	**224,439**	**212,096**	**361,361**	**580,122**
Total Supplies	**453,239**	**528,892**	**576,728**	**583,380**	**742,141**	**963,268**
Reserve or (Shortage)	**73,447**	**91,706**	**71,505**	**10,198**	**104,787**	**263,749**
Management Supply Factor	**1.19**	**1.21**	**1.14**	**1.02**	**1.16**	**1.38**

Figure 5C.8
Recommended Water Management Strategies for North Texas Municipal Water District

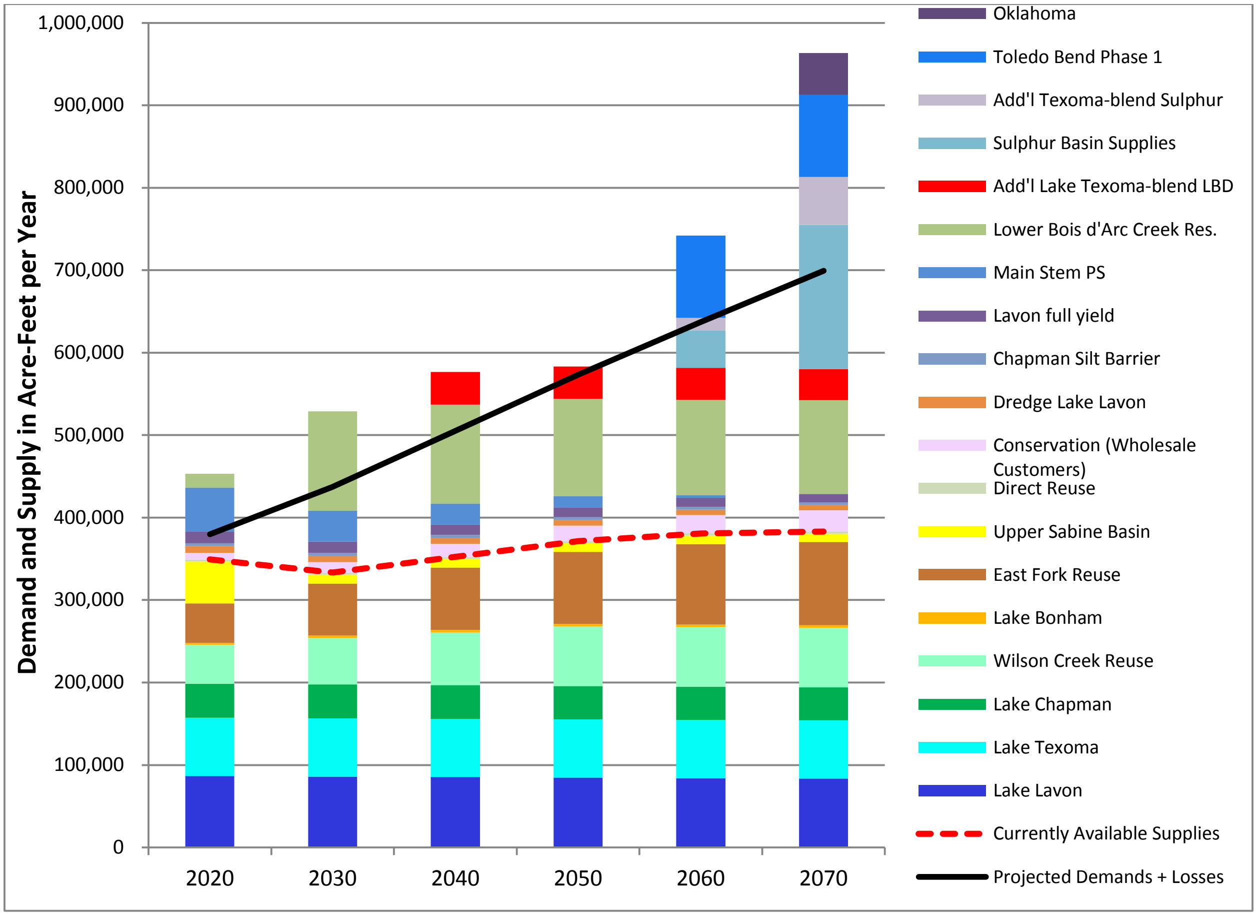


Figure 5C.9
North Texas Municipal's Water District's 2070 Additional Supply by Type (Acre-Feet per Year)

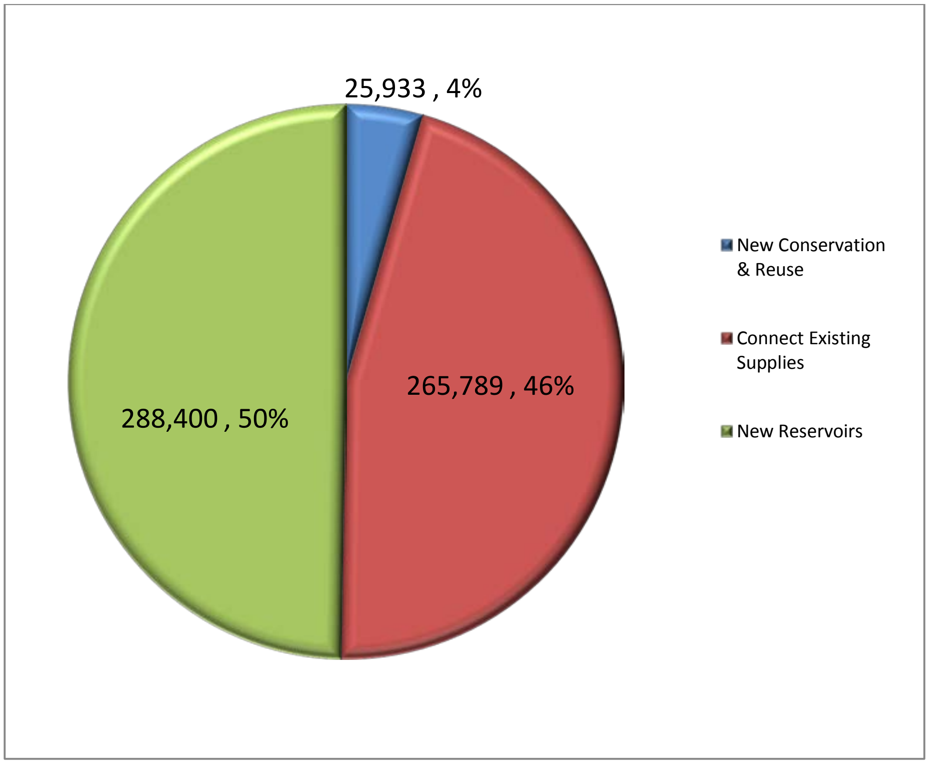


Table 5C.8
Summary of Costs for NTMWD Recommended Strategies

Strategy	Date to be Developed	Quantity for NTMWD (Ac-Ft/Yr)	NTMWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation*	2020	25,933	Included under County Summaries in Section 5D.			
Removal of Chapman Silt Barrier	2020	3,620	$1,793,000	$0.06	NA	Q-19
Dredge Lake Lavon	2020	7,959	$1,967,000	$0.06	NA	Q-20
Add'l measure to access full Lavon yield	2020	14,461	$20,823,000	$0.63	$0.26	Q-21
Main Stem Trinity PS	2020	53,088	$71,743,000	$0.47	$0.14	Q-22
Lower Bois d'Arc Creek	2020	120,200	$625,610,000	$1.55	$0.22	Q-23
Lake Chapman Pump Station Expansion	2020		$25,638,000	NA	NA	Q-24
Add'l Lake Texoma-blending Lower Bois d'Arc	2040	39,571	$174,179,000	$1.59	$0.46	Q-25

Strategy	Date to be Developed	Quantity for NTMWD (Ac-Ft/Yr)	NTMWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Sulphur Basin Supplies	2060	174,800	$1,206,634,000	$2.18	$0.51	Q-18
Add'l Lake Texoma-blending Sulphur Basin water	2060	58,267	$347,596,000	$1.97	$0.44	Q-26
Toledo Bend Phase 1	2060	100,000	$1,248,461,000	$4.07	$0.95	Q-57
Oklahoma	2070	50,000	$167,541,000	$1.56	$0.70	Q-27
Fannin Co Water Supply System	2020	12,760	$45,753,900	$2.80	$1.88	Q-150
Treatment and Distribution Improvements	2020-2070	554,189	$4,270,988,000	$2.57	$0.59	Q-28
Total NTMWD Capital Costs			**$8,208,736,900**			

* NTMWD has no retail sales, so conservation savings are reflected in their customers' conservation savings. NTMWD has an extensive water conservation program, the costs for which are not reflected in this table.

Table 5C.9
Summary of Costs for NTMWD Alternative Strategies

Strategy	Quantity for NTMWD (Ac-Ft/Yr)	NTMWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
			With Debt Service	After Debt Service	
Toledo Bend Reservoir Phase 2	100,000	$1,210,468,000	$4.01	$0.89	Q-15
Lake O' the Pines	87,900	$361,876,000	$1.66	$0.74	Q-29
Lake Texoma - Desalinate	39,235	$622,592,000	$7.20	$2.96	Q-30
Freestone/Anderson Co Groundwater (Forestar)	42,000	$230,043,000	$1.86	$0.45	Q-31
George Parkhouse Reservoir (North)	118,960	$729,557,000	$1.76	$0.35	Q-32
George Parkhouse Res. (South)	108,480	$857,396,000	$2.10	$0.34	Q-33
Marvin Nichols Reservoir	160,300	$1,042,498,000	$2.04	$0.52	Q-16

5C.1.5 City of Fort Worth

The City of Fort Worth obtains raw water from the Tarrant Regional Water District (TRWD) and treats and distributes treated water to about 30 other water user groups in Tarrant County and surrounding counties. The city also provides direct reuse water from Village Creek Wastewater Treatment Plant to meet non-potable water needs in the Cities of Arlington and Euless, Dallas-Fort Worth International Airport, and a few customers within the City of Fort Worth.

The currently available supply to Fort Worth is limited by Fort Worth's current treatment capacity and by TRWD's raw water sources and transmission capacity. As Fort Worth increases treatment capacity and TRWD develops additional raw water supplies, Fort Worth's available supply will increase. The city also plans to implement additional direct reuse projects, which would be used for industry, landscape irrigation, and steam electric power. The recommended water management strategies for the city of Fort Worth are:

- Conservation
- Additional supply from Tarrant Regional Water District
- Expansion of water treatment plants
- Direct reuse for industry, landscape irrigation, and steam electric power

These strategies are discussed individually below.

Conservation. The City of Fort Worth has invested significant effort in its conservation program and has seen measureable results. As a result, the per capita water use shown in this 2016 Region C Water Plan is 15% less than the per capita use for Fort Worth shown in the *2011 Region C Water Plan*. The per capita use included in this plan ranges from 176 gpcd in 2020 down to 169 gpcd in 2070. Additional savings are expected through more conservation strategies. The Conservation Water Management Strategy shown in this section is the sum of projected conservation savings for Fort Worth and its existing and potential customers, based on the Region C recommended water conservation program. This conservation strategy includes a significant capital outlay ($76 million) for an Advanced Meter Infrastructure (AMI) system, which results in additional estimated savings in 2020 and 2030. Any and all individual conservation strategies that Fort Worth choses to implement in the future shall be considered to be consistent with this Plan for the purposes of obtaining TWDB financing. Not including savings from low-flow plumbing fixtures (which are built into the demand projections), conservation by Fort Worth and its customers is projected to reach 24,777 acre-feet per year by 2070.

Additional Supply from Tarrant Regional Water District. As the Tarrant Regional Water District develops new supplies and increases transmission capacity, Fort Worth's allocation of supply from the District will increase to meet projected demands.

Expansions of Water Treatment Plants. The City of Fort Worth has five water treatment plants: North Holly, South Holly, Rolling Hills, Eagle Mountain, and Westside. The current combined capacity of the existing water treatment plants is 497 mgd. In order to meet the projected demands, Fort Worth will expand water treatment plants to reach a total treatment capacity of 920 mgd by 2070.

Direct Reuse. Fort Worth plans to implement the following direct reuse projects:

- Alliance Corridor Direct Reuse: This project would involve a partnership between the City of Fort Worth, Trinity River Authority and Hillwood Corporation to serve developments in the Alliance Airport area. It would use effluent supplied from the Trinity River Authority's Denton Creek Regional Wastewater System.
- Fort Worth Future Direct Reuse: Fort Worth plans to further expand its direct reuse system by constructing additional conveyance and/or treatment facilities in other areas of the City.

Table 5C.10 shows the recommended plan by decade for the city, and Table 5C.11 presents the costs associated with the recommended strategies. The estimated capital cost for Fort Worth's recommended water management strategies is approximately $1.2 billion, based on 2013 construction costs.

Table 5C.10
Summary of Recommended Water Management Strategies for Fort Worth

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Fort Worth Projected Population	*953,971*	*1,206,920*	*1,490,815*	*1,659,683*	*1,806,476*	*1,953,270*
Projected Demands (Fort Worth & Customers) (Table H.13)*	**292,423**	**348,026**	**410,390**	**455,416**	**497,352**	**540,757**
Existing Supplies						
TRWD Raw Water	*275,830*	*297,042*	*307,638*	*303,755*	*296,564*	*288,536*
Water Treatment Capacity (497 mgd Total)	*278,569*	*278,569*	*278,569*	*278,569*	*278,569*	*278,569*
TRWD Limited by Treatment	*275,830*	*278,569*	*278,569*	*278,569*	*278,569*	*278,569*
Waterchase Golf Course Direct Reuse	*897*	*897*	*897*	*897*	*897*	*897*
Village Creek Direct Reuse	*3,469*	*3,526*	*3,526*	*3,526*	*3,526*	*3,526*
Total Existing Supplies	***280,196***	***282,992***	***282,992***	***282,992***	***282,992***	***282,992***
Need (Demand - Supply)	***12,227***	***65,035***	***127,398***	***172,425***	***214,360***	***257,766***
Water Management Strategies						
Conservation (retail)	24,232	29,368	20,994	20,765	20,261	19,409
Conservation (wholesale)	1,560	2,326	3,074	3,871	4,581	5,368
Alliance Direct Reuse	2,800	2,800	7,841	7,841	7,841	7,841
Future Direct Reuse	2,688	6,934	8,166	8,166	8,166	8,166
Additional Raw Water Needed from TRWD with treatment as below:		32,924	95,863	138,092	176,941	216,981

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Eagle Mountain 35 mgd expansion		*19,618*	*19,618*	*19,618*	*19,618*	*19,618*
West Plant 23 mgd expansion		*12,892*	*12,892*	*12,892*	*12,892*	*12,892*
Rolling Hills 50 mgd expansion		*414*	*28,025*	*28,025*	*28,025*	*28,025*
West Plant 35 mgd expansion			*19,618*	*19,618*	*19,618*	*19,618*
Eagle Mountain 30 mgd expansion			*15,710*	*16,815*	*16,815*	*16,815*
50 mgd expansion-1				*28,025*	*28,025*	*28,025*
50 mgd expansion-2				*13,099*	*28,025*	*28,025*
50 mgd expansion-3					*23,923*	*28,025*
50 mgd expansion-4						*28,025*
50 mgd expansion-5						*7,913*
Total Supplies from Strategies	**31,280**	**74,352**	**135,939**	**178,735**	**217,790**	**257,766**
Total Supplies	**311,476**	**357,343**	**418,930**	**461,726**	**500,782**	**540,757**
Reserve or (Shortage)	**19,053**	**9,317**	**8,540**	**6,310**	**3,430**	**0**
Management Supply Factor	**1.07**	**1.03**	**1.02**	**1.01**	**1.01**	**1.00**

*For breakdown of wholesale customer demand, see Appendix H.

Table 5C.11
Summary of Costs for Fort Worth Recommended Strategies

Strategy	Developed Before:	Quantity for Fort Worth (Ac-Ft/Yr)	Fort Worth Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	19,409	$0	$1.05	$1.05	Q-10
Conservation - AMI	2020	11,266*	$76,000,000	$1.74	$0.00	Q-209
Conservation - WCCAP	2020	9,317*	$162,000,000	$4.47	$0.00	Q-212
Conservation (wholesale)	2020	5,368	Included under County Summaries in Section 5D.			
Alliance Direct Reuse	2020	7,841	$16,083,000	$0.49	$0.06	Q-68
Future Direct Reuse	2020	8,166	$129,976,000	$4.18	$0.82	Q-67
Additional TRWD	2020	216,981	$0	$0.97	$0.97	None
Eagle Mountain 35 mgd expansion	*2030*	*19,618*	*$68,472,000*	*$1.28*	*$0.38*	*Q-13*
West Plant 23 mgd expansion	*2030*	*12,892*	*$48,082,000*	*$1.37*	*$0.41*	*Q-13*
Rolling Hills 50 mgd expansion	*2030*	*28,025*	*$93,960,000*	*$1.23*	*$0.37*	*Q-13*
West Plant 35 mgd expansion	*2040*	*19,618*	*$68,472,000*	*$1.28*	*$0.38*	*Q-13*

Strategy	Developed Before:	Quantity for Fort Worth (Ac-Ft/Yr)	Fort Worth Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Eagle Mountain 30 mgd expansion	*2040*	*16,815*	*$59,977,000*	*$1.31*	*$0.39*	*Q-13*
50 mgd expansion-1	*2050*	*28,025*	*$93,960,000*	*$1.23*	*$0.37*	*Q-13*
50 mgd expansion-2	*2050*	*28,025*	*$93,960,000*	*$1.23*	*$0.37*	*Q-13*
50 mgd expansion-3	*2060*	*28,025*	*$93,960,000*	*$1.23*	*$0.37*	*Q-13*
50 mgd expansion-4	*2070*	*28,025*	*$93,960,000*	*$1.23*	*$0.37*	*Q-13*
50 mgd expansion-5	*2070*	*7,913*	*$93,960,000*	*$1.23*	*$0.37*	*Q-13*
Cost Participation in Water delivery line to Customers (Trophy Club and Westlake)	*2020*	*N/A*	*$5,233,000*	*N/A*	*N/A*	*Q-197*
Total Capital Costs			**$1,198,055,000**			

* Maximum volume between 2002-2070. 2070 volume is 0 acre-feet/year

5C.1.6 Trinity River Authority

The Trinity River Authority (TRA) currently provides water to Region C users in several ways:

- TRA provides water from its own water rights in four different lakes (Lakes Bardwell, Navarro Mills, Joe Pool, and Livingston).
- TRA purchases and treats water from the Tarrant Regional Water District (TRWD) and supplies Tarrant County cities through the Tarrant County Water Supply Project.
- TRA contracts with TRWD and provides raw water to water users in Ellis and Freestone Counties.
- TRA provides reuse water to entities in Dallas and Ellis Counties.

The Authority also owns and operates several wastewater treatment plants, and has plans to develop a number of direct and indirect reuse projects in Region C. The following water management strategies are recommended for TRA:

- Conservation
- Expansions of the Ellis County Water Supply Project
- Development of indirect reuse for Ennis from Lake Bardwell
- Development of indirect reuse through Joe Pool Lake
- Expansion of the existing Las Colinas reuse project in Dallas County with additional transmission facilities
- Development of reuse for steam electric power generation in Dallas County
- Development of reuse for steam electric power generation in Ellis County
- Development of reuse for steam electric power generation in Freestone County

- Development of reuse for steam electric power generation in Kaufman County
- Development of a reuse project from the Denton Creek WWTP for irrigation in Denton and Tarrant Counties and municipal use in Tarrant County
- Development of reuse from Central Regional WWTP to City of Irving
- Development of indirect reuse from Central Regional WWTP to North Texas Municipal Water District

These projects are discussed below.

Conservation. Conservation is the projected conservation savings for existing and potential customers of the TRA, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures (which are built into the demand projections) and not including reuse, conservation by TRA customers is projected to reach 3,829 acre-feet per year by 2070.

Expansions of the Ellis County Water Supply Project. The Ellis County Water Supply Project delivers raw water from the Tarrant Regional Water District (TRWD) pipelines to water suppliers in Ellis County. Raw water is diverted from the TRWD pipelines and treated at water treatment plants operated by Ennis, Waxahachie, Rockett SUD, and Midlothian. Table 5C.12 shows the proposed supply from TRWD through TRA for the Ellis County Water Supply Project, which is 74,659 acre-feet per year by 2070. The supply that is currently available for the Ellis County Water Supply Project is limited by local treatment facilities and by TRWD currently available supply. Treatment plant expansions by Ennis, Waxahachie, Rockett SUD, and Midlothian, and TRWD strategies to obtain additional raw water will make sufficient water available to meet all future needs. The capital costs for any of these expansions will be borne by local entities and the capital costs for any of these strategies will be borne by TRWD, so no capital costs are shown for TRA.

Development of Indirect Reuse for Ennis. Ennis currently discharges its treated wastewater downstream from Lake Bardwell. TRA has a water right that allows the reuse of up to 3,696 acre-feet per year of wastewater if discharged into Lake Bardwell. The existing direct reuse transmission line from the Ennis wastewater plant to a nearby power plant runs past Lake Bardwell, and water could be discharged from that pipeline to the lake for reuse. Ennis plans to implement this strategy as part of their water supply beginning in 2040.

Development of a Reuse Project for Joe Pool Lake. The Trinity River Authority has received a reuse permit for up to 4,368 acre-feet per year from a wastewater treatment plant in the watershed of Joe Pool Lake. Water would be discharged upstream of the lake for subsequent use from Joe Pool Lake. This project is assumed to be developed by 2020.

Table 5C.12
Supplies from TRWD through TRA for the Ellis County Water Supply Project

Water User Group	Demands and Supplies (Ac-Ft/Yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Ennis Municipal	4,148	4,789	5,447	7,397	11,879	19,748
Garrett	346	438	546	674	827	1,970
Rice WSC (part)	50	50	50	50	50	50
Ellis Co. Other	186	191	204	765	1,656	2,911
Ellis Co. Manufacturing (10%)	525	540	556	572	572	572
Ellis Co. Steam Electric	1,401	1,401	1,401	1,401	1,401	1,401
Total	**6,656**	**7,409**	**8,204**	**10,859**	**16,385**	**26,652**
Other Supplies	6,109	5,944	6,228	6,868	8,938	8,901
Conservation	168	426	518	742	1,242	2,175
Ennis Supply from ECWSP	**379**	**1,039**	**1,458**	**3,249**	**6,205**	**15,576**
Midlothian Municipal	4,198	5,429	7,069	8,589	9,956	10,995
Grand Prairie (part)	3,363	3,363	3,363	3,363	3,363	3,363
Mountain Peak SUD (net of Groundwater)	414	852	1,370	1,983	2,714	3,563
Rockett SUD	2,242	2,242	2,242	2,242	2,242	2,242
Venus (Region G)	429	519	615	724	842	971
Ellis Co. Manufacturing (40%)	262	270	278	286	286	286
Ellis Co. Steam Electric	224	224	224	224	224	224
Sardis-Lone Elm WSC	1,121	1,121	1,121	1,121	1,121	1,121
Total	**12,253**	**14,020**	**16,282**	**18,532**	**20,748**	**22,765**
Other Supplies (Joe Pool)	5,833	5,712	5,591	5,470	5,349	5,229
Conservation	129	232	349	615	1,068	1,313
Midlothian Supply from ECWSP	**6,291**	**8,076**	**10,342**	**12,447**	**14,331**	**16,223**
Rockett SUD Municipal	3,871	4,841	6,001	7,390	9,575	11,798
Bardwell	24	44	68	97	130	320
Ellis County Other (Boyce WSC and Bristol WSC)	519	519	519	519	519	519
Ellis County Other (future)	2,000	2,000	2,000	2,000	2,646	5,820
Ennis (part)	17	17	17	17	17	17
Ferris (net of Groundwater)	108	186	269	362	827	1,852
Lancaster (part)	90	90	90	90	90	90
Oak Leaf (part)	55	55	55	55	55	55
Palmer (net of Groundwater)	289	353	432	529	675	1,242
Pecan Hill	111	136	167	205	257	384
Red Oak (part)	1,230	1,230	1,230	1,230	1,230	1,230

Water User Group	Demands and Supplies (Ac-Ft/Yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Sardis-Lone Elm WSC (net of Groundwater)	2,166	3,055	4,086	4,600	4,950	4,948
Waxahachie (part)	613	613	613	613	613	613
Total	**11,093**	**13,139**	**15,547**	**17,707**	**21,584**	**28,888**
Other Supplies (Midlothian)	2,242	2,242	2,242	2,242	2,242	2,242
Conservation	126	208	272	372	503	692
Rockett SUD Supply from ECWSP	**8,725**	**10,689**	**13,033**	**15,093**	**18,839**	**25,954**
Waxahachie Municipal	6,872	7,741	9,320	11,299	13,749	16,715
Buena Vista-Bethel SUD (net of Groundwater)	673	673	898	1,299	2,245	3,280
Ellis County Other	745	762	815	1,036	1,257	1,850
Files Valley WSC (part)	0	57	61	66	73	79
Italy (part)	0	72	159	266	419	662
Maypearl (part)	117	135	145	143	143	143
Ellis Co. Manufacturing (28%)	2,242	2,242	2,242	2,242	2,242	2,242
Ellis Co. Steam Electric	0	0	2,116	4,129	4,484	4,484
Total	**10,649**	**11,682**	**15,756**	**20,480**	**24,612**	**29,455**
Other Supplies (Limited by Howard Plant Capacity)	11,212	11,373	11,806	12,021	11,722	11,586
Conservation	136	222	325	468	670	963
Waxahachie Supply from ECWSP (minimum 2,500 ac-ft per year)	**2,500**	**2,500**	**3,625**	**7,991**	**12,220**	**16,906**
Total	**17,895**	**22,304**	**28,458**	**38,780**	**51,595**	**74,659**

Expansion of the Existing Las Colinas Reuse Project in Dallas County with Additional Transmission Facilities. The Trinity River Authority currently supplies treated wastewater to Las Colinas in Irving for golf course irrigation, landscape irrigation, and lake level maintenance. This project would allow expansion of that supply by 7,000 acre-feet per year. It is assumed to be developed by 2020.

Development of Reuse for Steam Electric Power Generation in Dallas County. The projected 2070 demand for Dallas County Steam Electric Power is 11,066 acre-feet per year. It is assumed that TRA will supply up to 2,000 acre-feet per year of reuse water for part of that need (with most of the rest coming from Mountain Creek Lake and Dallas Water Utilities). The project cost is based on delivery of the water from the TRA Central Wastewater Treatment Plant to Mountain Creek Lake. It is assumed that the project will be developed by 2030. (TRA reuse projects may be located elsewhere in Dallas County, depending on the development of steam electric power generation facilities and/or the occurrence of other opportunities to meet water needs with reuse water. If that were to occur, then costs for the project might differ, but the project should still be considered consistent with the Region C Water Plan.)

Development of Reuse for Steam Electric Power Generation in Ellis County. The projected 2070 demand for Ellis County Steam Electric Power is 10,786 acre-feet per year. It is assumed that TRA will supply up to 4,700 acre-feet per year of reuse water for that need, beginning in 2060 with 2,200 acre-feet per year. The project cost is based on delivering water about 20 miles. (TRA reuse projects may be located anywhere in Ellis County, depending on the development of steam electric power generation facilities and/or the occurrence of other opportunities to meet water needs with reuse water. The costs for the project may differ, but the project should still be considered consistent with the Region C Water Plan.)

Development of Reuse for Steam Electric Power Generation in Freestone County. The projected 2070 demand for Freestone County Steam Electric Power is 40,175 acre-feet per year. The Trinity River Authority is already supplying 26,726 acre-feet per year for steam electric power in Freestone County (20,000 from upstream Lake Livingston diversions and 6,726 raw water provided by TRWD). It is assumed that TRA may supply up to 6,760 acre-feet per year of indirect reuse water to meet the remaining need. The project cost is based on diverting TRA treated return flows from the Trinity River and delivering the water about 15 miles. (TRA reuse projects may be located anywhere in Freestone County, depending on the development of steam electric power generation facilities and/or the occurrence of other opportunities to meet water needs with reuse water. The costs for the project may differ, but the project should still be considered consistent with the Region C Water Plan.)

Development of Reuse for Steam Electric Power Generation in Kaufman County. The projected 2070 demand for Kaufman County Steam Electric Power is 8,000 acre-feet per year. It is assumed that TRA may supply up to 1,000 acre-feet per year of indirect reuse water for that need (with the remainder coming from other sources). The project cost is based on diverting TRA treated return flows from the Trinity River and delivering the water about 15 miles. (TRA reuse projects may be located anywhere in Kaufman County, depending on the development of steam electric power generation facilities and/or the occurrence of other opportunities to meet water needs with reuse water. The costs for the project may differ, but the project should still be considered consistent with the Region C Water Plan.)

Development of Reuse Projects from the Denton Creek WWTP for Irrigation and Municipal Use in Denton and Tarrant Counties. The Trinity River Authority has been in discussions with potential water users regarding the development of up to 11,537 acre-feet per year of reuse water from TRA's Denton

Creek WWTP for irrigation and municipal use in Denton and Tarrant Counties. Costs for this strategy are based on 7,841 acre-feet per year direct reuse for Fort Worth and customers and the remainder as indirect reuse through Grapevine Lake. The capital costs for the direct reuse project will likely be borne by Fort Worth rather than TRA and that has been reflected in this plan.

Central Reuse to Irving. The City of Irving has a current contract with TRA for the option to purchase up to 25 million gallons per day (28,025 acre-feet per year) of effluent from TRA's Central Regional Wastewater Plant. Irving plans to develop a project to use this water within the next five years. Additional details on this project are in Section 5D under Irving.

Central Reuse to NTMWD (via Main Stem Pump Station). The North Texas Municipal Water District is developing an agreement with TRA to purchase up to 50 million gallons per day (56,050 acre-feet per year) of effluent from TRA's Central Regional Wastewater Plant. This effluent would be allowed to flow to the Main Stem of the Trinity River where NTWMD's Main Stem Pump Station would divert it into NTMWD's East Fork Wetlands system. NTWMD plans to utilize this reuse water until such time as return flows from their own wastewater treatment plants on the East Fork increase to the capacity of the wetlands system. Additional details on this project are in Section 5C.1 under NTMWD.

Table 5C.13 and Figure 5C.10 provide information on the recommended management strategies for TRA. A summary of the capital and unit cost for the strategies is shown in Table 5C.14.

Table 5C.13
Summary of Recommended Water Management Strategies for Trinity River Authority

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demands (Table H.31)	**204,867**	**198,487**	**199,369**	**205,574**	**212,053**	**233,806**
Currently Available Supplies						
Joe Pool Lake (Midlothian)	*5,833*	*5,712*	*5,591*	*5,470*	*5,349*	*5,229*
Joe Pool Lake (Grand Prairie)	*1,272*	*1,239*	*1,207*	*1,174*	*1,141*	*1,109*
Joe Pool Lake (Grand Prairie Raw)	*300*	*300*	*300*	*300*	*300*	*300*
Navarro Mills Lake	*18,333*	*17,325*	*16,317*	*15,308*	*14,300*	*13,292*
Lake Bardwell	*9,600*	*9,295*	*8,863*	*8,432*	*8,000*	*7,931*
Lake Livingston	*20,000*	*20,000*	*20,000*	*20,000*	*20,000*	*20,000*
Current Reuse	*11,604*	*12,007*	*12,739*	*13,254*	*13,254*	*13,254*
Current TRWD (Tarrant Co.)	*39,764*	*38,518*	*34,661*	*31,192*	*27,789*	*24,802*
Current TRWD (Ellis Co)	*14,959*	*16,543*	*17,664*	*21,997*	*24,979*	*25,273*
Current TRWD (Freestone Co SEP)	*6,726*	*6,122*	*5,411*	*4,781*	*4,264*	*3,806*
Currently Available Supplies	***128,391***	***127,060***	***122,752***	***121,908***	***119,377***	***114,996***

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Need (Demand - Supply)	*76,476*	*71,427*	*76,617*	*83,666*	*92,676*	*118,810*
Water Management Strategies						
Conservation	1,970	2,614	2,126	2,475	3,226	3,829
TRWD Water:						
Tarrant Co. WSP	0	1,629	6,922	11,204	14,388	17,205
Ellis Co. WSP	3,726	6,698	10,932	16,783	26,616	49,386
Freestone County SEP	0	604	1,315	1,945	2,462	2,920
Other Reuse Supplies (Ac-Ft/Yr)						
Ennis Indirect Reuse	0	0	518	1,392	3,696	3,696
Joe Pool Lake Reuse	1,914	2,835	4,041	4,368	4,368	4,368
Additional Los Colinas Reuse	7,000	7,000	7,000	7,000	7,000	7,000
Dallas County Reuse (SEP)	0	2,000	2,000	2,000	2,000	2,000
Ellis County Reuse (SEP)	0	0	0	0	2,200	4,700
Freestone Co. Reuse (SEP)	0	0	0	6,760	6,760	6,760
Kaufman Co. Reuse (SEP)	1,000	1,000	1,000	1,000	1,000	1,000
Tarrant and Denton Co. Reuse	3,921	3,921	11,537	11,537	11,537	11,537
Central Reuse to Irving	28,025	28,025	28,025	28,025	28,025	28,025
Central Reuse to NTMWD (via Main Stem Pump Station)	53,088	37,913	25,366	13,599	3,235	0
Total Supplies from Strategies	**100,644**	**94,240**	**100,783**	**108,088**	**116,512**	**142,426**
Total Supplies	**229,035**	**221,300**	**223,535**	**229,996**	**235,889**	**257,422**
Reserve or (Shortage)	**24,168**	**22,813**	**24,167**	**24,423**	**23,837**	**23,616**
Management Supply Factor	**1.12**	**1.11**	**1.12**	**1.12**	**1.11**	**1.10**

Figure 5C.10
Recommended Water Management Strategies for the Trinity River Authority in Region C

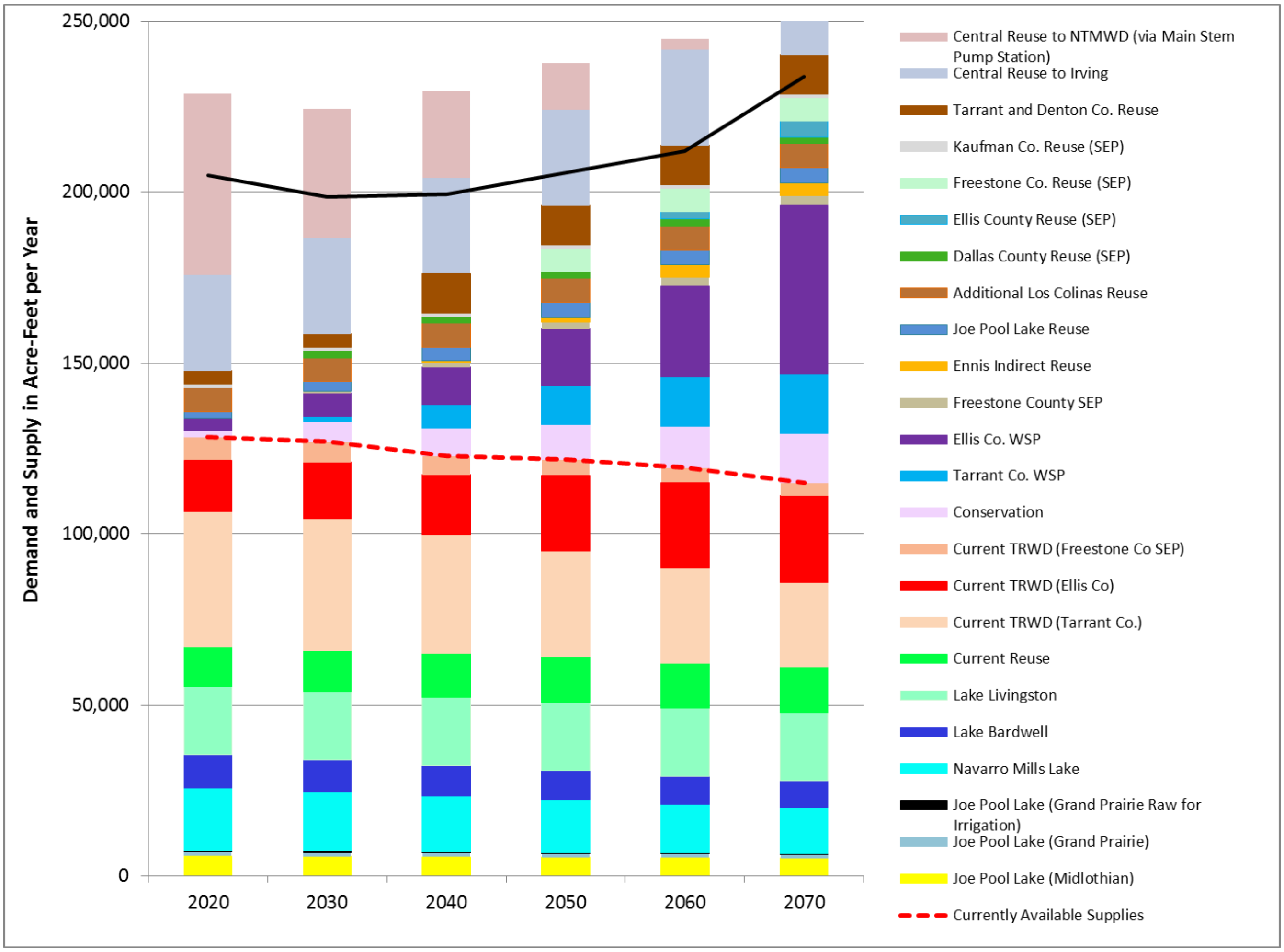


Table 5C.14
Summary of Costs for TRA Recommended Strategies

Strategy	Date to be Developed	Quantity for TRA (Ac-Ft/Yr)	TRA Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation**	2010	3,829	Included under County Summaries in Section 5D.			
TRWD Water:						
Tarrant Co. WSP	2020	17,205	$0	$0.97	$0.97	None
Ellis Co. WSP	2020	49,386	$0	$0.97	$0.97	None
Freestone County SEP	2020	2,920	$0	$0	$0	None

Strategy	Date to be Developed	Quantity for TRA (Ac-Ft/Yr)	TRA Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Ennis Indirect Reuse	2040	3,696	Included in Ennis costs in Table 5D.41			
Joe Pool Lake Reuse*	2020	4,368	N/A	N/A	N/A	None
Additional Los Colinas Reuse	2020	7,000	$15,017,000	$1.20	$0.65	Q-58
Dallas County Reuse (SEP)	2030	2,000	$8,661,000	$1.81	$0.70	Q-59
Ellis County Reuse (SEP)	2060	4,700	$17,958,000	$1.71	$0.72	Q-60
Freestone Co. Reuse (SEP)	2050	6,760	$30,593,000	$1.88	$0.72	Q-61
Kaufman Co. Reuse (SEP)	2020	1,000	$8,763,000	$2.87	$0.87	Q-62
Tarrant and Denton Co. Reuse	2020	11,537	Included in Fort Worth costs in Table 5C.10.			
Central Reuse to Irving	2020	28,025	Included in Irving costs in Section 5D.			
Central Reuse to NTMWD (via Main Stem Pump Station)	2020	53,088	Included in NTMWD costs in Table 5C.8			
Total TRA Capital Costs			**$80,992,000**			

*There is no cost to get water in the lake. Capital costs and purchase costs to get the supply out of the lake are to be determined by who uses the supply.
** TRA has no retail sales, so conservation savings are reflected in their customers' conservation savings.

5C.1.7 Upper Trinity Regional Water District

The Upper Trinity Regional Water District (UTRWD) currently supplies treated water to users in Denton County and Collin County. The UTRWD also provides direct reuse for irrigation in Denton County. The currently available supplies for UTRWD include water purchased from Commerce out of Chapman Lake, purchased raw water from Dallas Water Utilities (DWU) and indirect reuse. UTRWD's currently available supplies range from 54,995 acre-feet per year in 2020 to 41,002 acre-feet per year in 2070. (The changes in supply over time are due primarily to changes in water availability from DWU and the expiration of UTRWD's contract with Commerce.) Considering losses associated with treatment and distribution, UTRWD needs to develop an additional 94,203 acre-feet per year by 2070. UTRWD will also need to develop additional treatment and distribution capacity to serve the growing demands of its current and future customers. The recommended water management strategies for UTRWD include the following:

- Conservation
- Removal of Chapman Lake Silt Barrier
- Additional supplies from DWU under current contracts
- Lake Ralph Hall
- Indirect reuse of return flows from Lake Ralph Hall

- Additional Direct Reuse
- Contract Renewal with Commerce for Chapman Lake supply and reuse
- Additional DWU supplies under new contract
- Sulphur Basin Supplies
- Water treatment plant and distribution system improvements.

The Sulphur Basin Supplies strategy is a multi-provider strategies and is discussed at the beginning of this chapter. The other strategies identified for UTRWD are discussed individually below:

Conservation. Conservation is the projected conservation savings for UTRWD's existing and potential customers, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures and not including reuse, conservation by UTRWD customers is projected to reach 4,498 acre-feet per year by 2070.

Removal of Silt Barrier at Chapman Lake Intake Pump Station. UTRWD shares an intake structure with NTMWD and Irving at Chapman Lake. NTMWD is in the design phase of a project that would remove a silt barrier in Chapman Lake. This silt barrier currently limits the amount of water reaching the intake structure at the lake. This project will allow for use of full yield of Chapman Lake. This project is expected to be completed before 2020.

Additional Supplies from DWU under Current Contracts. UTRWD's current contracts with DWU indicate that DWU will supply (1) water needed for several specific water suppliers in Denton County plus an additional 10 mgd and (2) an additional amount equal to 40 percent of UTRWD's supplies from Chapman Lake. Based on projected demands, the contracts would provide up to 49,507 acre-feet per year in 2070. UTRWD is currently using less than the amount in this contract (due to the availability of other water supplies) but plans to eventually use the full contracted amount.

Lake Ralph Hall. In September 2013, UTRWD was granted a Texas water right permit to develop the proposed Lake Ralph Hall on the North Sulphur River in Fannin County. UTRWD is currently pursuing a Section 404 permit from the U.S. Army Corps of Engineers for this lake. The project would yield 34,050 acre-feet per year, at least 90 percent of which would be delivered to Denton County. (Up to 10% could meet local needs around the lake.) Water would be pumped from Lake Ralph Hall to the existing balancing reservoir on the pipeline from Chapman Lake to UTRWD's Harpool Water Treatment Plant and Lewisville Lake. From the balancing reservoir, it would be delivered through existing facilities to the Harpool plant and/or Lake Lewisville. (UTRWD has a contract with the City of Irving for joint use of the facilities owned by Irving. These existing facilities with minor modifications have sufficient capacity for the new supply.)

Indirect Reuse of Return Flows from Lake Ralph Hall. UTRWD plans to apply for the right to reuse return flows from the Lake Ralph Hall project, which by the District's water right are assumed to be 60 percent of the supply delivered to Denton County from the project, or 18,387 acre-feet per year. (This is the volume of supply that will be used to calculate the unit cost of the Lake Ralph Hall with Indirect Reuse strategy.) It will take some years before the full return flow amount is available. Currently much of the area to which UTRWD provides water service is rural and has individual septic systems. It is anticipated that as the area grows, municipal sewer collection systems will be developed, resulting in increased return flow. It is estimated that by 2070, the return flow available for reuse will be 16,071 acre-feet per year.

Additional Direct Reuse. UTRWD plans to develop up to an additional 2,240 acre-feet per year of direct reuse in Denton County. The specific location of this supply is uncertain and will depend on demands in UTRWD's service area.

Contract renewal with Commerce for Chapman Lake supply and reuse. A portion of UTRWD's supply in Chapman Lake provided under the existing contract with the City of Commerce could expire as early as 2041. It is UTRWD's intent to negotiate and renew or "reinstate" use of this water under the existing contract with Commerce.

Additional Water from Dallas Water Utilities. In addition to the water supplied by DWU under the existing contract between UTRWD and DWU, UTRWD plans to contract for additional surface water supplies from DWU. It is anticipated the existing contact will be renewed in 2021, and UTRWD will begin taking some additional water by 2050, with the project fully implemented by 2060. This supply is expected to be 5,605 acre-feet per year in 2050 and 11,210 acre-feet per year by 2060.

Water Treatment and Distribution Improvements. UTRWD will need to make improvements to its water treatment and distribution system to meet the demands of its customers. UTRWD has developed a capital improvement plan with specific projects through 2029, and estimated costs for improvements after 2029 are also included.

Table 5C.15 and Figure 5C.11 show the recommended plan for water supply development for UTRWD. Based on the recommended plan, 27 percent of the projected 2070 supply for UTRWD will be from conservation and reuse. Table 5C.16 gives information on the capital and unit costs for the recommended water management strategies.

If any of the projects identified in the recommended plan are not implemented, the UTRWD may wish to pursue alternative strategies. The following alternative water management strategies are recommended for UTRWD:

- George Parkhouse Reservoir (North)
- George Parkhouse Reservoir (South)
- Marvin Nichols Reservoir (328 feet, msl)
- Red River Off Channel Reservoir (partner with Dallas Water Utilities)
- Lake Texoma
- Toledo Bend Reservoir
- Oklahoma (UTRWD has permits pending for supply from Kiamichi River, Boggy Creek, and Oklahoma's portion of Lake Texoma. UTRWD would pursue one of these three options.)
- Additional reuse.

Information on the alternative strategies is shown on Table 5C.17.

Table 5C.15
Summary of Recommended Water Management Strategies
for Upper Trinity Regional Water District

Planned Supplies by Source (Acre-Feet per Year)	2020	2030	2040	2050	2060	2070
Demands (Table H.32)	**46,264**	**66,224**	**84,720**	**106,619**	**119,703**	**135,205**
Existing Supplies						
*DWU**	*37,307*	*40,513*	*37,930*	*35,231*	*33,087*	*31,490*
Chapman	*11,356*	*11,303*	*8,438*	*8,399*	*8,360*	*5,547*
Chapman Reuse	*5,435*	*5,575*	*4,287*	*4,392*	*4,497*	*3,068*
Direct Reuse	*897*	*897*	*897*	*897*	*897*	*897*
Total Existing Supplies	***54,995***	***58,288***	***51,552***	***48,919***	***46,841***	***41,002***
Need (Demand - Supply)	**0**	**7,936**	**33,168**	**57,700**	**72,862**	**94,203**
Contracted Amount from DWU*	**39,126**	**46,718**	**48,978**	**49,346**	**49,545**	**49,507**
New Supplies						
Conservation (wholesale customers)	876	1,713	2,388	3,206	3,803	4,498
Chapman Silt Barrier	998	972	945	918	891	864
Additional Supplies from DWU (Up to Current Contracts)*	1,819	6,205	11,048	14,115	16,458	18,017
Lake Ralph Hall		34,050	34,050	34,050	34,050	34,050

Planned Supplies by Source (Acre-Feet per Year)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Lake Ralph Hall Indirect Reuse		9,733	14,967	15,335	15,703	16,071
Additional Direct Reuse		560	1,121	2,240	2,240	2,240
Contract Renewal with Commerce for Chapman Lake supply			2,813	2,799	2,786	5,547
Contract Renewal with Commerce for Chapman Lake reuse			1,428	1,464	1,500	3,069
Additional DWU (New Contract)				5,605	11,210	11,210
Sulphur Basin Supplies					9,083	35,000
Treatment and Distribution System Improvements	*2,817*	*51,520*	*66,372*	*76,526*	*93,921*	*126,068*
Supplies from Strategies	**3,693**	**53,233**	**68,760**	**79,732**	**97,724**	**130,566**
Total Supplies	**58,688**	**111,521**	**120,312**	**128,651**	**144,565**	**171,568**
Reserve or (Shortage)	**12,424**	**45,297**	**35,593**	**22,032**	**24,862**	**36,363**
Management Supply Factor	**1.27**	**1.68**	**1.42**	**1.21**	**1.21**	**1.27**

* Under the existing contracts, UTRWD is entitled to 39,126 acre-feet per year from Dallas in 2020. However, given limited Dallas supplies in 2020 UTRWD's supply allocation from Dallas was limited proportionally to the total demand on Dallas and the supplies available to Dallas.

Figure 5C.11
Recommended Water Management Strategies for the Upper Trinity Regional Water District

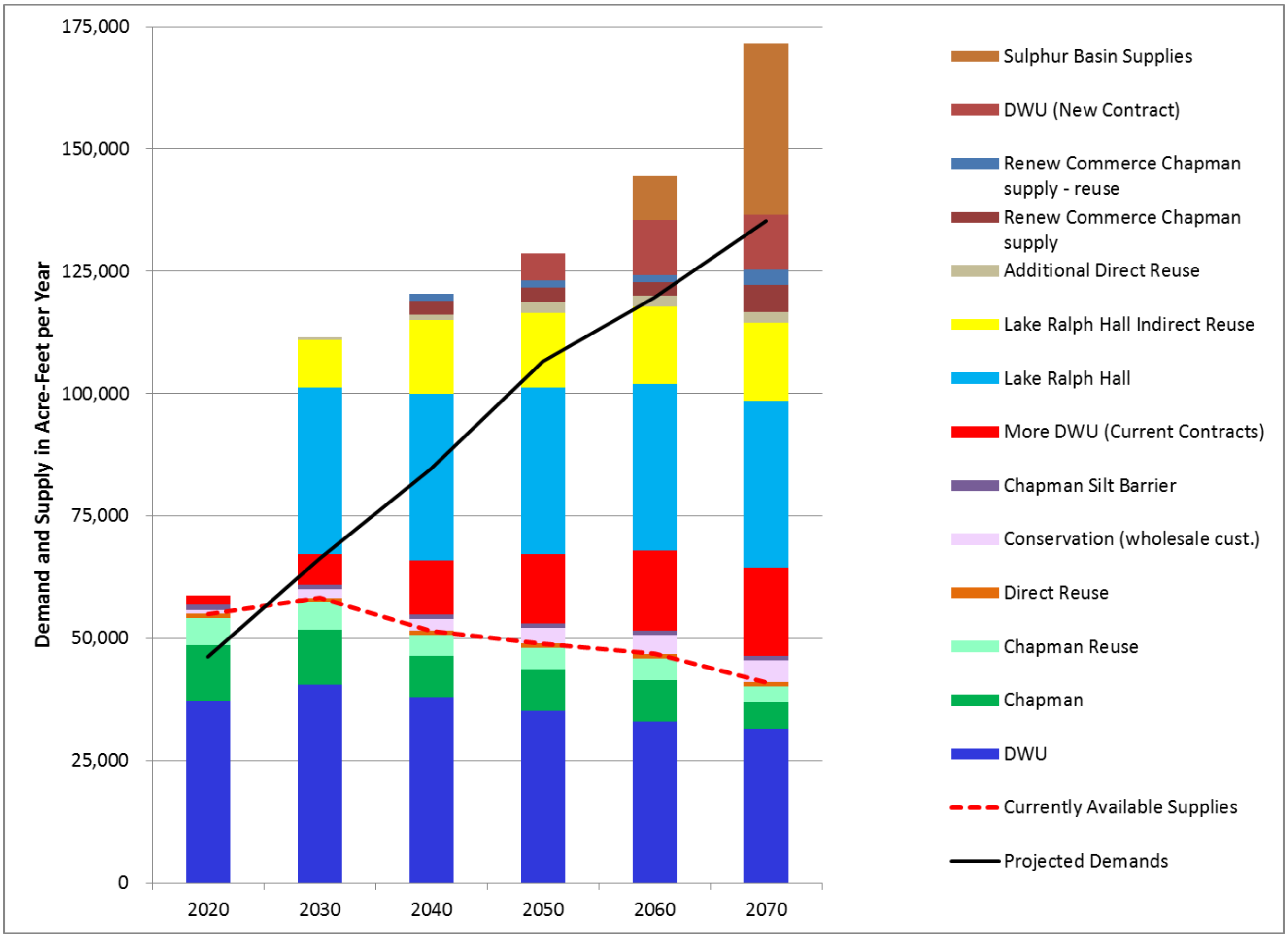


Table 5C.16
Summary of Costs for UTRWD Recommended Strategies

Strategy	Date to be Developed	Quantity for UTRWD (Ac-Ft/Yr)	UTRWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation***	2020	4,498	Included under County Summaries in Section 5D.			
Chapman Silt Barrier	2020	998	Included under NTMWD in Table 5C.8.			
Additional Supplies from DWU (Up to Current Contracts)	2020	18,017	$0	$1.48	$1.48	None
Lake Ralph Hall	2030	34,050	$316,160,000	$1.79	$0.25	Q-52
Lake Ralph Hall Indirect Reuse**	2030	16,071	$0	$0	$0	None

Strategy	Date to be Developed	Quantity for UTRWD (Ac-Ft/Yr)	UTRWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Additional Direct Reuse	2030	2,240	$13,213,000	$1.81	$0.29	Q-53
Renew Commerce Chapman	2040	5,547	$0	$0.01	$0.01	None
Renew Commerce Chapman - Reuse	2040	3,069	$0	$0	$0	None
Additional DWU (New Contract)	2050	11,210	$0	$1.48	$1.48	None
Sulphur Basin Supplies	2060	35,000	$305,499,000	$2.78	$0.65	Q-18
Treatment and Distribution System Improvements	*2020-2070*	*126,068*	$690,554,000	$2.79	$1.58	Q-54
Total UTRWD Capital Costs			**$1,325,426,000**			

*UTRWD has no retail sales, so conservation savings are reflected in their customers' conservation savings.
**Cost estimate to be calculated on ultimate reuse supply of 18,387 acre-feet per year.
***UTRWD has no retail sales, so conservation savings are reflected in their customers' conservation savings.

Table 5C.17
Summary of Costs for UTRWD Alternative Strategies

Strategy	Date to be Developed	Quantity for UTRWD (Ac-Ft/Yr)	UTRWD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
George Parkhouse Reservoir (North)	2060	35,000	$327,344,000	$2.81	$0.58	Q-32A
George Parkhouse Reservoir (South)	2060	35,000	$390,980,000	$3.05	$0.46	Q-33A
Marvin Nichols Reservoir	Unknown	35,000	$294,717,000	$2.61	$0.66	Q-16
Red River Off-Channel Reservoir	Unknown	15,000	$852,987,000	$2.53	$0.73	Q-44
Lake Texoma	Unknown	25,000	$197,198,000	$2.76	$0.74	Q-26A
Toledo Bend Reservoir	2070	48,000	$752,836,473	$5.17	$1.10	Q-15
Oklahoma	Unknown	15,000	$103,993,000	$2.70	$0.99	Q-55
Additional Reuse	Unknown	15,000	$1,000,000	$0.02	NA	Q-56

5C.1.8 Greater Texoma Utility Authority

The Greater Texoma Utility Authority (GTUA) provides water to Pottsboro, Sherman, manufacturing in Grayson County (through Sherman and Howe), Marilee SUD, Grayson County Other, South Grayson WSC, and customers of the Collin-Grayson Municipal Alliance. The Collin-Grayson Municipal Alliance is a pipeline to deliver water from NTMWD to Anna, Howe, Melissa and Van Alstyne in southern Grayson and Northern Collin Counties. GTUA is planning to participate in the Grayson County Water Supply Project and is expected to provide water to around 25 water user groups in Grayson and Collin Counties by 2070. The GTUA has an existing water right for 83,200 acre-feet per year from Lake Texoma. Of this amount, 11,200 acre-feet per year (limited by the Sherman water treatment plant capacity) is available to existing customers as potable water. Another 6,163 acre-feet per year is available as raw water for a proposed steam electric power plant near Sherman.

The combined 2070 demand for the Grayson County Water Supply Project and local Steam Electric demands on GTUA is almost 60,000 acre-feet per year. Although GTUA has enough raw water supply to meet this demand, significant treatment and delivery infrastructure will need to be constructed to deliver water supply to the participants of the Project. It is not clear at this time how the participating entities will divide the development or the costs of the Grayson County Water Supply Project. For this plan, the costs (other than for Sherman’s and Denison’s treatment plants) are shown under GTUA.

The 2070 demand of the Collin-Grayson Municipal Alliance (CGMA) is over 30,000 acre-feet per year. The treated water supply for this system is purchased from North Texas Municipal Water District. The current capacity of the system is 5,400 acre-feet per year, so GTUA will need to purchase additional water from NTWMD and construct additional infrastructure to deliver this supply to participants.

To meet the needs of the Grayson County Water Supply Project and CGMA, the following strategies are recommended:

- Conservation
- Additional Power Plant delivery
- Collin-Grayson Municipal Alliance East-West Pipeline
- Collin-Grayson Municipal Alliance Parallel Pipeline
- Grayson County Water Supply Project

These strategies are discussed individually below.

Conservation. Conservation is the projected conservation savings for the GTUA's existing and potential customers, based on the recommended Region C water conservation program. Water savings by the GTUA and customers is projected to reach 2,820 acre-feet per year by 2070.

Additional Power Plant Delivery. GTUA may supply up to 6,548 acre-feet per year of Lake Texoma water to Sherman for delivery to a proposed power plant (Grayson County Steam Electric WUG). It is assumed that the delivery of additional power plant water supplies will require the construction of facilities to divert water from Lake Texoma. For the purposes of estimating costs, a peak delivery of 12 mgd and a pipeline length of 15 miles is assumed. The new power plant or plants may be located anywhere in Grayson County, depending on the development of steam electric power generation facilities. The costs for the project may differ from the estimate, but the project should still be considered consistent with the Region C Water Plan. This Grayson County Steam Electric demand may alternatively be met by reuse supply from Sherman.

GTUA may supply up to 9,000 acre-feet per year of Lake Texoma water to a proposed power plant in Fannin County (Fannin County Steam Electric WUG). It is assumed that the delivery of this supply will require release of water from Lake Texoma to a downstream diversion location in Fannin County, and will require the construction of facilities to divert water from the Red River. For the purposes of estimating costs, a peak delivery of 12 mgd and a pipeline length of 15 miles is assumed. The new power plant or plants may be located anywhere in Fannin County, depending on the development of steam electric power generation facilities. The costs for the project may differ from the estimate, but the project should still be considered consistent with the Region C Water Plan.

Grayson County Water Supply Project. The Grayson County Water Supply Project will provide water to Grayson County water suppliers. The project includes expansions to Sherman's and Denison's existing water treatment plants, a new Sherman water treatment plant with expansion, two other treatment plants in the county (a plant north of Pottsboro and the Northwest Plant near Highway 377), and pipelines to deliver treated water to suppliers. As mentioned previously, it is not clear at this time how the participating entities will divide the development or the costs of the Grayson County Water Supply Project. For this plan, the costs (other than for Sherman's and Denison's treatment plants) are shown under GTUA.

Collin-Grayson Municipal Alliance Pipeline East-West Pipeline. GTUA is purchasing water from NTMWD for customers of the Collin-Grayson Municipal Alliance Pipeline Project (Anna, Howe, Melissa, and Van Alstyne). These supplies are currently transferred through McKinney's distribution system on a temporary basis (delivery of up to 5,400 acre-feet per year or so). The proposed east-west pipeline will replace the transfer through McKinney's system and increase the delivery to about 16,800 acre-feet per year. It should be noted that this pipeline may not be needed if NTWMD constructs a treated water supply line from its Wylie water treatment plant to this area.

Collin-Grayson Municipal Alliance Parallel Pipeline. The proposed parallel pipeline for the Collin-Grayson Municipal Alliance is needed to increase the delivery capacity for the system beyond 16,800 acre-feet per year.

In addition to these strategies, GTUA may participate in the Fannin County Water Supply Project (described in the section under North Texas Municipal Water District) and may work with Gainesville to serve multiple WUGs in Cooke County.

Table 5C.18 and Figure 5C.12 show the recommended plan for water supply development for the GTUA. Table 5C.19 presents the capital and unit costs for the recommended water management strategies.

Table 5C.18
Recommended Water Management Strategies
for the Greater Texoma Utility Authority

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demands (Table H.17)	**19,725**	**38,222**	**42,897**	**50,793**	**67,717**	**90,350**
Treated Water Demand	*13,562*	*16,511*	*21,186*	*29,082*	*46,006*	*68,639*
Raw Water Demand	*6,163*	*21,711*	*21,711*	*21,711*	*21,711*	*21,711*
Currently Available Supplies						
Lake Texoma (Potable-Limited by Sherman WTP)	11,210	11,210	11,210	11,210	11,210	11,210
Supply for Pottsboro (from Denison)	362	492	560	560	560	560
Collin-Grayson Municipal Alliance Pipeline Project (From NTMWD)	1,661	2,160	3,375	5,400	5,400	5,400
Potable Water Available	**13,233**	**13,862**	**15,145**	**17,170**	**17,170**	**17,170**
*Lake Texoma Raw (current use)**	6,163	6,163	6,163	6,163	6,163	6,163
Total Currently Available Supplies	**19,396**	**20,025**	**21,308**	**23,333**	**23,333**	**23,333**
Treated Water Need (Demand-Supply)	**329**	**2,649**	**6,041**	**11,912**	**28,836**	**51,469**
Raw Water Need (Demand-Supply)	**0**	**15,548**	**15,548**	**15,548**	**15,548**	**15,548**

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Conservation (Wholesale Customers)	361	700	724	1,126	1,806	2,820
Texoma Raw water to Grayson Co SEP	0	6,548	6,548	6,548	6,548	6,548
Texoma Raw water to Fannin Co SEP	0	9,000	9,000	9,000	9,000	9,000
Grayson County Water Supply Project	187	1,990	4,333	7,214	13,903	25,528
Add'l NTMWD (Current CGMA Facilities)	142	659	1,708	0	0	0
CGMA-East West Pipeline (NTMWD)	0	0	0	4,698	11,400	11,400
Parallel CGMA Pipeline (NTMWD)	0	0	0	0	3,533	14,541
Supplies from Strategies	**690**	**18,897**	**22,313**	**28,586**	**46,190**	**69,837**
Total Supplies	**20,086**	**38,922**	**43,621**	**51,919**	**69,523**	**93,170**
Total Potable Supplies	**13,923**	**17,211**	**21,910**	**30,208**	**47,812**	**71,459**
Reserve or (Shortage)	**361**	**700**	**724**	**1,126**	**1,806**	**2,820**
Management Supply Factor	**1.02**	**1.02**	**1.02**	**1.02**	**1.03**	**1.03**

* GTUA has a water right in Texoma for 83,200 acre-feet per year. Currently, they have facilities to use 11,210 acre-feet per year of treated water and 6,163 acre-feet per year of raw water. Use of additional water will require additional facilities.

Figure 5C.12
Recommended Water Management Strategies for GTUA

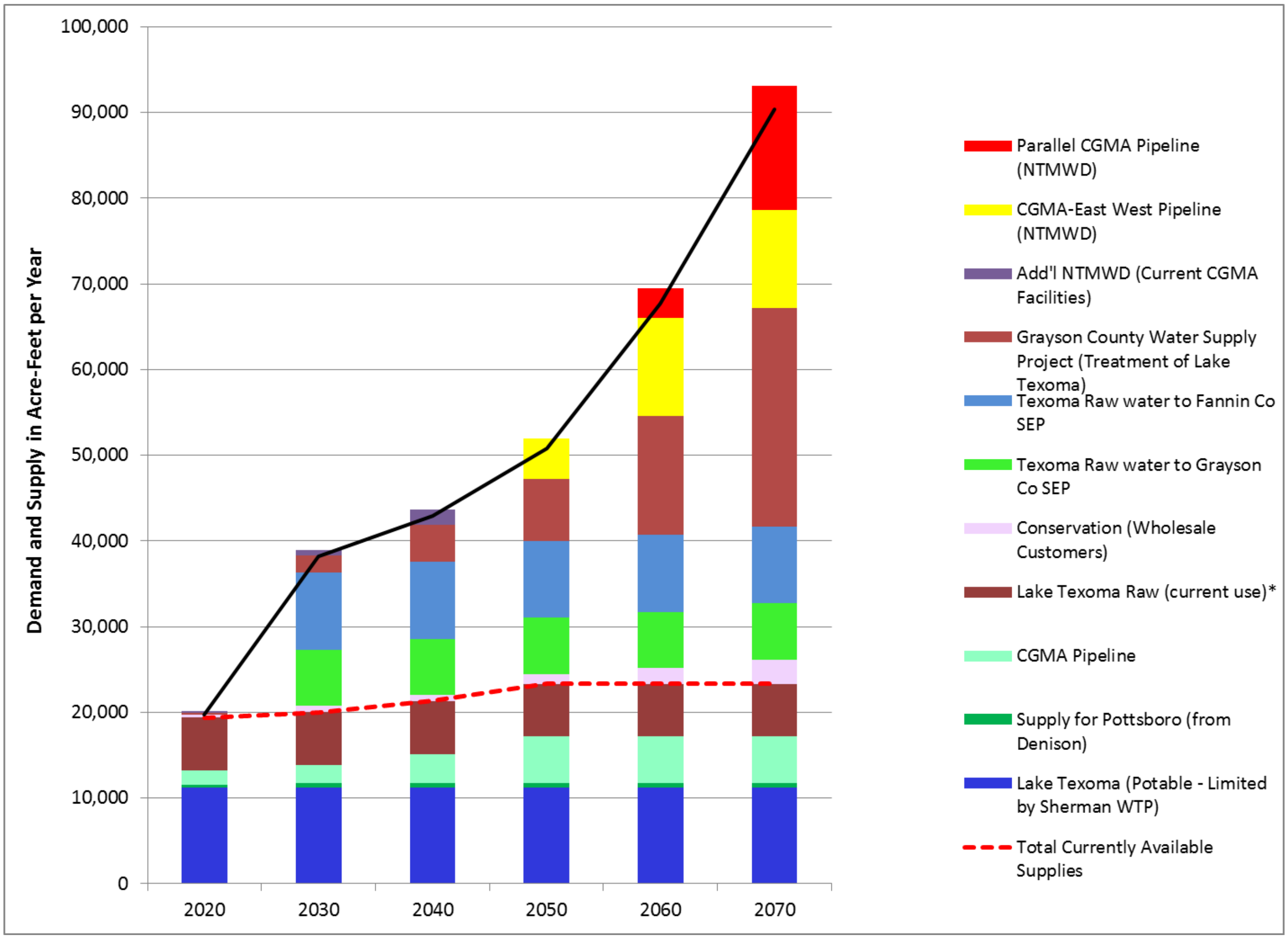


Table 5C.19
Summary of Costs for GTUA Recommended Strategies

Strategy	Date to be Developed	Quantity for GTUA (Ac-Ft/Yr)	GTUA Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation*	2020	2,820	Included under County Summaries in Section 5D.			
Texoma Raw water to Grayson Co SEP	2030	6,548	$24,356,000	$1.19	$0.24	Q-63
Texoma Raw water to Fannin Co SEP	2030	9,000	$25,026,000	$0.88	$0.16	Q-128
Grayson County Water Supply Project	2020	25,528	$92,840,000	$2.58	$1.64	Q-64

Strategy	Date to be Developed	Quantity for GTUA (Ac-Ft/Yr)	GTUA Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Add'l NTMWD (Current CGMA Facilities)	2020	1,708	$0	$1.75	$1.75	None
CGMA-East West Pipeline (NTMWD)	2050	11,400	$3,672,000	$2.69	$2.60	Q-65
Parallel CGMA Pipeline (NTMWD)	2060	14,541	$59,492,000	$3.78	$2.73	Q-66
Total GTUA Capital Costs			**$205,386,000**			

* GTUA has no retail sales, so conservation savings are reflected in their customers' conservation savings.

5C.1.9 Dallas County Park Cities Municipal Utility District

Dallas County Park Cities MUD supplies treated water to Highland Park and University Park and plans to continue doing so through the planning period. The MUD also sells reuse water from Lake Grapevine to the City of Grapevine for municipal and irrigation purposes. The MUD gets its water supplies from Lake Grapevine and has enough supply to meet projected demands through the planning period. The only strategy proposed for the MUD is the implementation of water conservation measures by its wholesale customers. The MUD has some amount of unused yield in Lake Grapevine, and an alternative strategy for the City of Grapevine would be to purchase some of this unused yield, up to 5,000 acre-feet per year.

Table 5C.20 shows the projected demand and supplies for Dallas County Park Cities MUD. Table 5C.21 gives information on the costs for the recommended water management strategy.

Table 5C.20
Recommended Water Management Strategies
for the Dallas County Park Cities Municipal Utility District

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Demands (Table H.7)	**14,989**	**15,333**	**15,249**	**15,171**	**15,157**	**15,156**
Currently Available Supplies						
Lake Grapevine (Potable)	16,900	16,750	16,600	16,450	16,300	16,150
Reuse	3,311	3,677	3,716	3,701	3,698	3,698
Currently Available Supplies	***20,211***	***20,427***	***20,316***	***20,151***	***19,998***	***19,848***
Need (Demand-Supply)	***0***	***0***	***0***	***0***	***0***	***0***

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Conservation (Wholesale Customers)	100	171	182	237	290	344
Supplies from Strategies	**100**	**171**	**182**	**237**	**290**	**344**
Total Supplies	**20,311**	**20,598**	**20,498**	**20,388**	**20,288**	**20,192**
Total Potable Supplies	**17,000**	**16,921**	**16,782**	**16,687**	**16,590**	**16,494**
Reserve or (Shortage)	**5,322**	**5,265**	**5,249**	**5,217**	**5,131**	**5,036**
Management Supply Factor	**1.13**	**1.10**	**1.10**	**1.10**	**1.09**	**1.09**

Table 5C.21
Summary of Costs for Dallas County Park Cities MUD Recommended Strategy

Strategy	Date to be Developed	Quantity for DCPCMUD (Ac-Ft/Yr)	DCPCMUD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation	2020	344*	Included under County Summaries in Section 5D.			
Total DCPCMUD Capital Costs			**$0**			

* DCPCMUD has no retail sales, so conservation savings are reflected in their customers' conservation savings.

5C.1.10 City of Corsicana

The City of Corsicana provides municipal and manufacturing water to much of Navarro County and portions of Ellis, Hill, and Limestone Counties. Future projected demands include steam electric power generation as well as municipal and manufacturing demands. The city's current water sources include Lake Halbert, Richland-Chambers Reservoir, and Navarro Mills Lake. The city also has a water right for 13,650 acre-feet per year from Richland-Chambers Reservoir. The supply currently available to Corsicana from Navarro Mills Reservoir is limited to 11,210 acre-feet per year because of the existing water treatment plant capacity. The supply from Lake Halbert and Richland Chambers is limited to 2,240 acre-feet per year for the same reason. To meet the projected water demands, the city will need to develop more than 11,000 acre-feet per year of additional supplies by 2070. The recommended strategies to meet these needs include:

- Conservation
- Increase pump station capacity to deliver additional water from Richland-Chambers Lake and Lake Halbert Water Treatment Plant
- Raw water supply from Richland-Chambers Lake for Proposed Power Plant

- Expansion of Lake Halbert Water Treatment Plant

These strategies are discussed individually below.

Conservation. Conservation is the projected conservation savings for the City of Corsicana and its existing and potential customers, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures (which are built into the demand projections), conservation by Corsicana and its customers is projected to reach 529 acre-feet per year by 2070.

New Water Treatment Plant to treat water delivered from Richland-Chambers Lake to Lake Halbert. The existing Water Treatment Plant at Lake Halbert has a peak capacity of 4 mgd. The facilities are aging, and Lake Halbert has no reliable supply. Corsicana has already built a pipeline and a 4 MGD pump station from Richland-Chambers reservoir to Lake Halbert. In order to increase the reliable water supply, the city will increase the capacity of the Richland-Chambers pump station and construct a new 8 mgd water treatment plant, taking the existing 4 mgd plant out of service.

Raw Water for Power Plant. Corsicana's projected demands include raw water for steam electric power generation in Navarro County. For the purpose of this plan, it is assumed that there will be one plant with a demand of 5,400 acre-feet per year. The facilities to service this demand will include a pump station in Richland-Chambers Lake and a 10 mile pipeline. If the supplies needed for this plant or the distance from the lake are different from these assumed values, the cost of these strategies will change, but the strategy will still be considered to be consistent with this plan.

Water Treatment Plant Expansion. As demands for treated water increase, Corsicana will expand the Lake Halbert Water Treatment Plant (by an additional 8 mgd). This expansion will require an expansion of the pump station at Richland-Chambers Reservoir to deliver the additional water to the Halbert treatment plant.

Table 5C.22 and Figure 5C.13 show the recommended water management strategies for Corsicana. Table 5C.23 provides the capital and unit costs for the recommended strategies. The estimated cost for Corsicana's recommended water management strategies is approximately $75.6 million, based on 2013 construction costs. Table 5C.24 shows the estimated cost for Corsicana's alternative strategy, which is the expansion of the existing Navarro Mills Water Treatment Plant.

Table 5C.22
Summary of Recommended Water Management Strategies for Corsicana

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands (Table H.4)	**11,463**	**17,807**	**18,795**	**20,337**	**22,438**	**25,114**
Currently Available Supplies						
Lake Halbert/Richland-Chambers	*13,863*	*13,855*	*13,847*	*13,838*	*13,830*	*13,822*
Navarro Mills Lake	*17,828*	*17,325*	*16,317*	*15,308*	*14,300*	*13,292*
Total	*31,691*	*31,180*	*30,163*	*29,147*	*28,130*	*27,114*
Total Supply limited by WTP Capacity = 24 MGD (20 MGD Navarro Mills, 4 MGD Halbert)	***13,452***	***13,452***	***13,452***	***13,452***	***13,452***	***13,452***
Need (Demand - Supply)	***0***	***4,355***	***5,343***	***6,885***	***8,986***	***11,662***
Water Management Strategies						
Conservation (retail)	110	170	210	254	306	364
Conservation (wholesale customers)	30	44	47	72	112	165
New 8 MGD Halbert/ Richland-Chambers WTP (4 mgd increase from current plant)	2,242	2,242	2,242	2,242	2,242	2,242
Raw Water for Power Plant		5,440	5,440	5,440	5,440	5,440
8 MGD Expansion of Halbert/Richland Chambers WTP and expansion of pump station				4,484	4,484	4,484
Total Supplies from Strategies	**2,382**	**7,896**	**7,939**	**12,492**	**12,584**	**12,695**
Treated Water Supply	15,834	15,908	15,951	20,504	20,596	20,707
Raw Water Supply	0	5,440	5,440	5,440	5,440	5,440
Total Supplies	**15,834**	**21,348**	**21,391**	**25,944**	**26,036**	**26,147**
Surplus or (Shortage)	**4,371**	**3,541**	**2,596**	**5,607**	**3,598**	**1,033**
Management Supply Factor	**1.38**	**1.20**	**1.14**	**1.28**	**1.16**	**1.04**

Figure 5C.13
Recommended Water Management Strategies for Corsicana

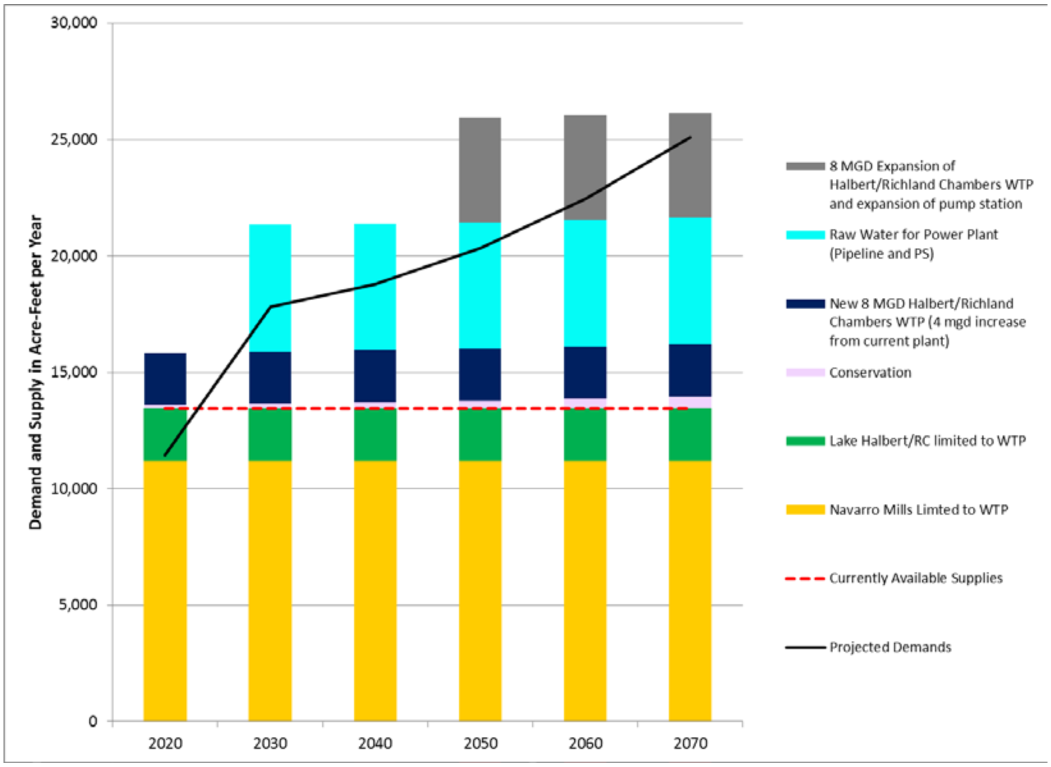


Table 5C.23
Summary of Costs for Corsicana Recommended Strategies

Strategy	Date to be Developed	Quantity for Corsicana (Ac-Ft/Yr)	Corsicana Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	364	$248,252	$2.36	$1.06	Q-10
Conservation (wholesale customers)	2020	165	Included under County Summaries in Section 5D.			
New 8 MGD Halbert/Richland Chambers WTP (4 mgd increase from current plant)	2020	2,242	$37,370,000	$6.11	$1.83	Q-12
Raw Water for Power Plant (Pipeline and PS)	2030	5,440	$16,331,000	$0.99	$0.22	Q-167
8 MGD Expansion of Halbert/Richland Chambers WTP and expansion of pump station	2050	4,484	$21,689,000	$1.77	$0.53	Q-13
Total Corsicana Capital Costs			**$75,638,252**			

Table 5C.24
Summary of Costs for Corsicana Alternative Strategies

Strategy	Date to be Developed	Quantity for Corsicana (Ac-Ft/Yr)	Corsicana Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Navarro Mills WTP Expansion	Unknown	5,605	$25,951,000	$1.70	$0.51	Q-13
Total Corsicana Capital Costs			**$25,951,000**			

5C.1.11 Sabine River Authority

The Sabine River Authority (SRA) is based in the North East Texas Region (D) and the East Texas Region (I), with a small area in the Sabine Basin in Region C. The SRA currently provides water from its Upper Basin reservoirs (Lake Tawakoni and Lake Fork Reservoir) to water users in Region C. These sources are fully contracted and SRA has requests for additional water in the Upper Basin. The SRA plans to participate in the Toledo Bend Reservoir Project that would transport water to the Upper Basin area and Region C. The Sabine River Authority is also seeking an amendment to its existing water right in Toledo Bend Reservoir for an additional 293,300 acre-feet per year of water supply. This amendment has been submitted to the Texas Commission on Environmental Quality and declared administratively complete. The North East Texas Region and the East Texas Region will develop management strategies for the Sabine River Authority.

5C.1.12 Sulphur River Municipal Water District

The Sulphur River Municipal Water District is located primarily in the North East Texas Region (D). The District supplies water to Upper Trinity Regional Water District (by contract with Commerce) and North Texas Municipal Water District (by contract with Cooper) in Region C. The North East Texas Region will develop any water management strategies needed for the Sulphur River Municipal Water District.

5C.1.13 Upper Neches River Municipal Water Authority

The Upper Neches River Municipal Water Authority (UNRMWA) is located in the East Texas (I) Region. UNRMWA has a contract to provide water from Lake Palestine for Dallas Water Utilities, and DWU is planning to connect that supply during the planning cycle. The East Texas Region will be responsible for developing any water management strategies needed for the UNRMWA.

5C.1.14 Sulphur River Basin Authority

The Sulphur River Basin Authority (SRBA) is located in the North East Texas Region (D). SRBA has notified both Region C and Region D of their intent to become active in the regional planning process and develop supplies in the Sulphur River Basin which may be used by both Region D and Region C entities in the future. In September 2015, the Region C Water Planning Group voted to designate SRBA as a Wholesale Water Provider.

5C.2 Recommended Strategies for Local Wholesale Water Providers

5C.2.1 Argyle Water Supply Corporation

The Argyle Water Supply Corporation provides retail service in Denton County inside the city of Argyle and in areas surrounding the city. Since the WSC supplies water to the city of Argyle, for the purpose of regional planning, the WSC is considered to be a wholesale water provider. The Argyle WSC uses local groundwater and purchases treated water from Upper Trinity Regional Water District. Increased demands for Argyle WSC are expected to be supplied by Upper Trinity Regional Water District. Table 5C.25 summarizes the recommended water management strategies for Argyle WSC. The only capital costs anticipated for Argyle WSC are for conservation, which are shown on Table 5C.26.

Table 5C.25
Summary of Recommended Water Management Strategies for Argyle WSC

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.1)	**2,391**	**3,055**	**3,956**	**3,951**	**3,949**	**3,948**
Existing Supplies						
Groundwater (outside Argyle)	*500*	*500*	*500*	*500*	*500*	*500*
Groundwater (inside Argyle)	*450*	*450*	*450*	*450*	*450*	*450*
UTRWD (outside Argyle)	*532*	*548*	*491*	*402*	*367*	*322*
UTRWD (inside Argyle)	*909*	*1,184*	*1,471*	*1,201*	*1,097*	*962*
Currently Available Supplies	***2,391***	***2,682***	***2,912***	***2,553***	***2,414***	***2,234***
Needs (Demands - Supplies)	**0**	**373**	**1,044**	**1,398**	**1,535**	**1,714**
Water Management Strategies						
Conservation (outside Argyle)	24	38	42	45	48	51
Conservation (inside Argyle)	36	100	158	168	178	187
Additional UTRWD (outside Argyle)	0	0	56	194	274	316
Additional UTRWD (inside Argyle)	0	375	977	1,279	1,416	1,541
Total from Strategies	**60**	**513**	**1,233**	**1,686**	**1,916**	**2,095**

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Total Supplies	**2,451**	**3,195**	**4,145**	**4,239**	**4,330**	**4,329**
Surplus or (Shortage)	**60**	**140**	**189**	**288**	**381**	**381**
Management Supply Factor	**1.03**	**1.05**	**1.05**	**1.07**	**1.10**	**1.10**

Table 5C.26
Summary of Costs for Argyle WSC Recommended Strategies

Strategy	Date to be Developed	Quantity for Argyle WSC (Ac-Ft/Yr)	Argyle WSC Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (outside Argyle)	2020	51	$77,847	$2.86	$1.16	Q-10
Conservation (inside Argyle)	2020	187	Included under County Summaries in Section 5D.			
Additional UTRWD	2020	1,857	$0	$3.00	$3.00	None
Total Argyle WSC Capital Costs			**$77,847**			

5C.2.2 City of Arlington

Arlington does not currently have any wholesale customers, but supplies retail service in Arlington (including some of Tarrant County Manufacturing within the city). This plan calls for Arlington to begin providing wholesale water supplies to Bethesda Water Supply Corporation, Pantego, Kennedale, and potentially to Grand Prairie. Arlington purchases raw water from the Tarrant Regional Water District (TRWD). Sources of this water are Lake Arlington and the TRWD reservoir system. The city also obtain some direct reuse supplies from Fort Worth, replacing treated water previously used for irrigation. As shown on Table 5C.27, Arlington will continue to obtain raw water from TRWD out of system water and Lake Arlington. Arlington currently has enough capacity to deliver and treat its 2070 demand. Water management strategies for Arlington include conservation and continued and increased purchase of water from TRWD. Table 5C.28 shows the capital costs for Arlington's recommended strategies. It should be noted that Arlington has significant future capital expenditures planned for its water system ($180 million over the next ten years). However, these expenditures will be focused on upgrading and ensuring dependability in treatment and in distribution system delivery capability, and as such do not provide any additional water supply and have not been included as part of this plan. The improvements should be considered to be consistent with this plan for the purposes of qualifying for TWDB funding. In addition, Arlington has already implemented significant conservation strategies (full time leak detection, new automatic meters, and other elements) to help meet the conservation goals.

Table 5C.27
Summary of Recommended Water Management Strategies for Arlington

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.2)	**72,206**	**75,437**	**76,908**	**77,603**	**78,891**	**79,539**
Existing Supplies						
Fort Worth Direct Reuse	178	178	178	178	178	178
TRWD (Lk Arlington and TRWD System)	72,028	68,467	61,699	55,011	49,884	44,891
Limit of Current Plant Capacity (75 mgd PB South; 97.5 mgd John F. Kubala)	96,686	96,686	96,686	96,686	96,686	96,686
Total Currently Available Supplies	**72,206**	**68,645**	**61,877**	**55,189**	**50,062**	**45,069**
Needs (Demands - Supplies)	**0**	**6,792**	**15,031**	**22,414**	**28,829**	**34,470**
Water Management Strategies						
Conservation (retail)	1,284	1,962	2,216	2,332	2,571	2,806
Conservation (wholesale)	31	50	104	146	176	200
Additional Raw Water from TRWD	0	4,780	12,711	19,936	26,082	31,464
Total Supplies from Strategies	**1,315**	**6,792**	**15,031**	**22,414**	**28,829**	**34,470**
Total Supplies	**73,521**	**75,437**	**76,908**	**77,603**	**78,891**	**79,539**
Surplus or (Shortage)	**1,315**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.02**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.28
Summary of Costs for Arlington Recommended Strategies

Strategy	**Date to be Developed**	**Quantity for Arlington (Ac-Ft/Yr)**	**Arlington Share of Capital Costs**	**Unit Cost ($/1000 gal)**		**Table for Details**
				With Debt Service	**After Debt Service**	
Conservation (retail)	2020	2,806	$3,066,441	$3.60	$0.64	Q-10
Conservation (wholesale)	2020	200	Included under County Summaries in Section 5D.			
Add'l Water from TRWD	2030	31,464	$0	$.0.97	$.0.97	None
Total Arlington Capital Costs			**$3,066,441**			

5C.2.3 Athens Municipal Water Authority

Athens Municipal Water Authority supplies water to meet municipal and manufacturing demands in the City of Athens. The Authority also supplies local demand for lawn irrigation around Lake Athens and is contracted to supply 3,023 acre-feet per year for the Athens Fish Hatchery, located at Lake Athens (and in Region I, the East Texas Region). Athens MWA has a right to divert 8,500 acre-feet per year from Lake Athens. Athens MWA also owns a groundwater well on their water treatment plant property. The well produces approximately 966 acre-feet per year. The well is not operational yet but Athens MWA plans to start using the supplies shortly. The fish hatchery returns approximately 95 percent of the water it diverts to Lake Athens, which serves to increase the supply from the lake, but the hatchery is under no contractual obligation to continue this practice. The total projected shortages for Athens MWA are 5,987 acre-feet per year by 2070.

Recognizing the limitations of its existing supplies, Athens MWA has obtained a reuse permit that allows the City of Athens to discharge its treated wastewater effluent to Lake Athens for reuse. The reuse permit is for 2,677 acre-feet per year, but a recent study shows that this strategy is less economically feasible than other alternatives. At this time, Athens MWA and the City of Athens are not pursuing reuse of City of Athens wastewater through Lake Athens.

The recommended water management strategies for Athens MWA are as follows:

- Conservation
- Upgrades to the Booster Pump Station at the treatment plant
- Indirect reuse to Lake Athens from fish hatchery
- New wells in the Carrizo-Wilcox aquifer.

These strategies are discussed in greater detail below.

Conservation. Conservation is the projected conservation savings for the City of Athens. These savings are based on the Region C recommended water conservation program for the City of Athens. Not including savings from low-flow plumbing fixtures (already built into the projected demands) conservation by AMWA is projected to reach 457 acre-feet per year by 2070.

Upgrades to the Booster Pump Station at Treatment Plant. Existing treatment capacity for City of Athens is 8 MGD, with a 7.5 MGD treated water pipeline to the city of Athens. The total yield from Lake Athens and the groundwater well at the water treatment plant property is approximately 6 MGD. The water treatment plant has sufficient capacity to treat the current supplies. Since the future supply from the groundwater wells will be directly added to the distribution system, there is no need for water treatment plant capacity improvements. However, the Booster Pump station at the water treatment plant is limited by its capacity (5 MGD) and age. Athens MWA plans to replace the existing pump station with a new 8 MGD pump station. Therefore, the second recommended water management strategy for Athens MWA is to address the booster pump station infrastructure improvements at the water treatment plant.

Indirect Reuse at the Fish Hatchery. Another recommended strategy is the indirect Reuse of flows returned from Fish Hatchery to Lake Athens. Currently, approximately 95 to 100 percent of the diverted water for the Fish Hatchery is returned to Lake Athens; however, the Fish Hatchery is under no contractual obligations to continue this practice. To assure adequate supplies for the fish hatchery and other uses, Athens MWA should work with the fish hatchery to assure that the hatchery continues to return diverted water to Lake Athens for subsequent reuse. For purposes of this plan, it is assumed that 95 percent of the contracted water will be returned. This equates to 2,872 acre-feet per year of additional supply.

Below is a summary of the Alternative Strategies proposed for Athens MWA.

New Groundwater Wells. Athens MWA is currently pursuing developing groundwater from Carrizo-Wilcox aquifer on the property near Lake Athens. It is anticipated that eight new wells (at 750 gallons per minute each) would be drilled to provide a total of 4 MGD of groundwater supply. The water would be transported directly from the well field to the distribution system. The first well will be online in 2016. It should be noted that although Athens MWA has permits to develop the wells, this strategy cannot be included in the 2016 Regional Plan as a recommended strategy for this entity because of TWDB modeled available groundwater (MAG) limitations. The Carrizo-Wilcox aquifer in Henderson County (both in Region C and I) is severely limited by the MAG for additional wells. Therefore, the groundwater wells is included as an alternative strategy for Athens MWA in the 2016 Regional Plan. The strategy will be changed to a recommended strategy if the MAG volumes are updated in the near future. Since this is the primary strategy for Athens MWA and the construction is already underway, the 2016 Regional Plan will show shortages for Athens MWA, which in reality will be addressed by the well field development.

City of Athens Reuse. Another Alternative water management strategies for Athens MWA is the Reuse of City of Athens Discharges. Recognizing the limitations of its existing supplies, Athens MWA has received a reuse permit that allows the City of Athens to discharge its wastewater effluent to Lake Athens, which can then be rediverted for use. The reuse permit is for 2,677 acre-feet per year. However, a recent study shows that this strategy is less economically feasible than other alternatives. At this time, Athens MWA and the City of Athens are not pursuing reuse to Lake Athens.

Table 5C.29 and Figure 5C.14 show the recommended plan for Athens MWA. Table 5C.30 gives a summary of costs for the recommended strategies. Table 5C.31 gives capital costs for those alternative strategies.

Table 5C.29
Recommended Water Management Strategies for Athens MWA

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.3)						
Treated Water from Athens MWA	2,473	2,755	2,996	3,344	6,030	9,340
Raw Water from Athens MWA	3,193	3,193	3,193	3,193	3,193	3,193
Total from Athens MWA	**5,666**	**5,948**	**6,189**	**6,537**	**9,223**	**12,533**
Currently Available Supplies						
Lake Athens (Firm Yield Available to Region C)	*5,983*	*5,903*	*5,822*	*5,741*	*5,660*	*5,580*
Existing Well in Carrizo Wilcox	*966*	*966*	*966*	*966*	*966*	*966*
Total Currently Available Supplies	***6,949***	***6,869***	***6,788***	***6,707***	***6,626***	***6,546***
Need (Demand - Current Supplies)	***0***	***0***	***0***	***0***	***2,597***	***5,987***
Water Management Strategies						
Conservation	59	98	119	144	277	457
Fish Hatchery Reuse	2,872	2,872	2,872	2,872	2,872	2,872
Infrastructure Improvements at WTP	*1,682*	*1,682*	*1,682*	*1,682*	*1,682*	*1,682*
Supplies from Strategies	**2,931**	**2,970**	**2,991**	**3,016**	**3,149**	**3,329**
Total Supplies	**9,880**	**9,839**	**9,779**	**9,723**	**9,775**	**9,875**
Surplus or (Shortage)	**4,214**	**3,891**	**3,590**	**3,186**	**552**	**-2,658**
Management Supply Factor	**1.74**	**1.65**	**1.58**	**1.49**	**1.06**	**0.79**

Note: Treated demands are demands for Athens and part of Henderson County manufacturing less Athens groundwater supplies. Demands for raw water are for the fish hatchery and lawn irrigation around Lake Athens. Conservation is City of Athens conservation in Regions C and I.

Figure 5C.14
Recommended Water Management Strategies for Athens MWA

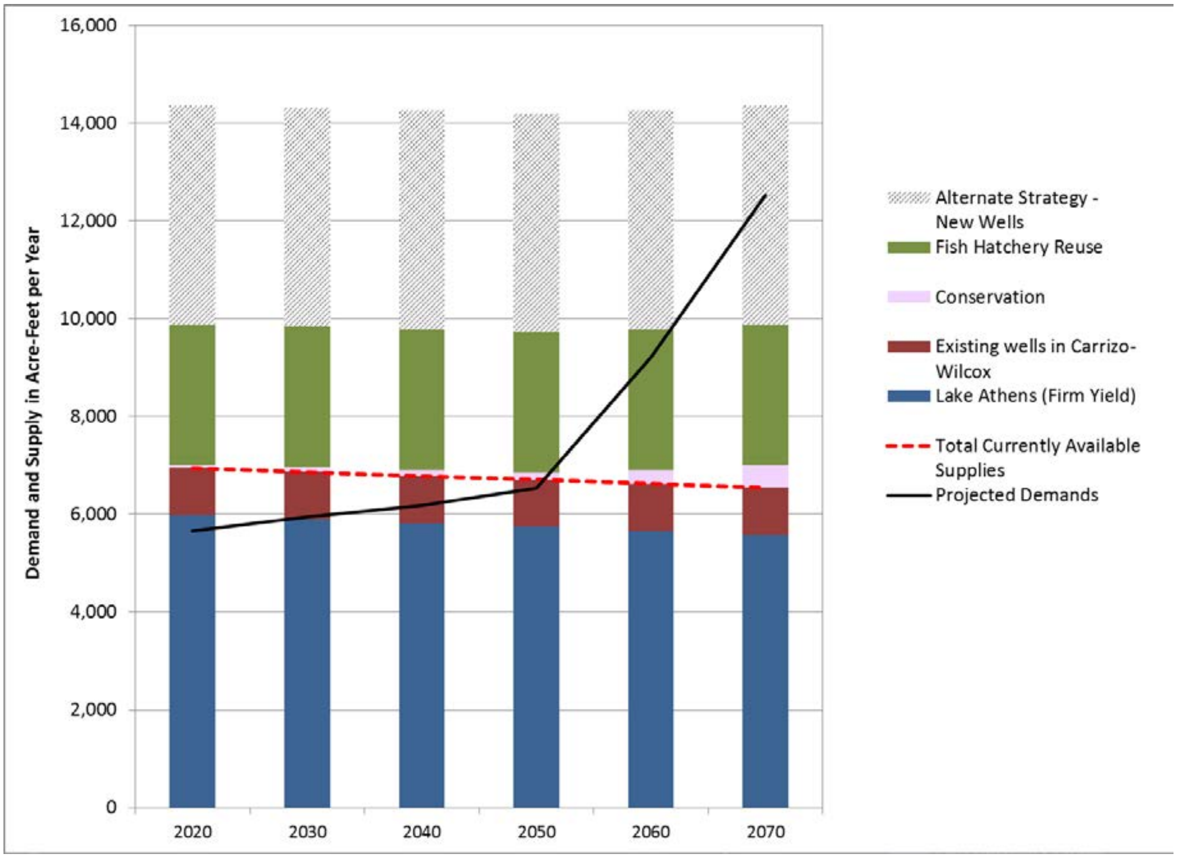


Table 5C.30
Summary of Costs for Athens MWA Recommended Strategies

Strategy	Date to Be Developed	Quantity for Athens MWA (Ac-Ft/Yr)	Athens MWA Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation	2020	457*	Included under County Summaries in Section 5D.			
Fish Hatchery Reuse	2020	2,872	N/A	$0.10	$0.10	None
Infrastructure Improvements at WTP	*2020*	*1,682*	$2,900,000	$0.18	$0.11	Q-145
Total Athens MWA Capital Costs			**$2,900,000**			

*Athens MWA has no retail sales, so conservation savings are reflected in their customers' conservation savings.

Table 5C.31
Summary of Costs for Athens MWA Alternative Strategies

Strategy	Date to be Developed	Quantity for Athens MWA (Ac-Ft/Yr)	Athens MWA Share of Capital Costs	Unit Cost ($/ 1000 gal)		Table for Details
				With Debt Service	After Debt Service	
New Groundwater wells	2020	4,480	$9,455,000	$0.85	$0.35	Q-144
City of Athens Reuse	2040	2,677				

5C.2.4 Cross Timbers Water Supply Corporation

The Cross Timbers Water Supply Corporation (previously named Bartonville Water Supply Corporation) provides retail service in Denton County. The WSC supplies water to the residents of Bartonville, Copper Canyon, and Double Oak, and to a portion of Denton County Other (rural population) and is therefore considered to be a wholesale water provider. Cross Timbers WSC uses local groundwater and purchases treated water from Upper Trinity Regional Water District (UTRWD). Increased demands for Cross Timbers WSC are expected to be supplied by UTRWD. Table 5C.32 summarizes the recommended water management strategies for Cross Timbers WSC. The only capital costs anticipated for Cross Timbers WSC are for infrastructure needed to take delivery from UTRWD and to deliver water to customers, which are shown on Table 5C.33. UTRWD, rather than Cross Timbers WSC, is responsible for cost of facilities to treat and deliver water from UTRWD to Cross Timbers WSC.

Table 5C.32
Summary of Recommended Water Management Strategies for Cross Timbers WSC

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.5)	**1,819**	**1,923**	**1,953**	**1,988**	**2,037**	**2,091**
Existing Supplies						
Groundwater	*800*	*800*	*800*	*800*	*800*	*800*
Currently Available from UTRWD	*1,019*	*947*	*805*	*696*	*675*	*612*
Currently Available Supplies	***1,819***	***1,747***	***1,605***	***1,496***	***1,475***	***1,412***
Needs (Demands - Supplies)	***0***	***176***	***347***	***492***	***562***	***679***
Water Management Strategies						
Conservation (wholesale)	31	48	54	61	68	76
Additional UTRWD	0	208	452	673	814	923
Infrastructure to take delivery from UTRWD and deliver water to customers	*0*	*208*	*452*	*673*	*814*	*923*

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Total from Strategies	**31**	**256**	**506**	**734**	**882**	**999**
Total Supplies	**1,850**	**2,003**	**2,112**	**2,230**	**2,357**	**2,411**
Reserve or (Shortage)	**31**	**80**	**159**	**242**	**320**	**320**
Management Supply Factor	**1.02**	**1.04**	**1.08**	**1.12**	**1.16**	**1.15**

Table 5C.33
Summary of Costs for Cross Timbers WSC Recommended Strategies

Strategy	Date to be Developed	Quantity for Cross Timbers WSC (Ac-Ft/Yr)	Cross Timbers WSC Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation	2020	76	Included under County Summaries in Section 5D.			
Additional UTRWD	2030	923	$0	$3.00	$3.00	None
Infrastructure to take delivery from UTRWD and deliver water to customers	*2020*	*923*	$5,858,000	$1.96	$0.34	Q-99
Total Cross Timbers WSC Capital Costs			**$5,858,000**			

5C.2.5 City of Denison

The City of Denison currently provides treated water to residents of Denison, Pottsboro and rural areas of Grayson County, and provides raw water to Grayson County Manufacturing users. Denison's current sources of water supply are groundwater, Lake Randell, and Lake Texoma. It should be noted that Denison's water right in Lake Randell is 5,280 acre-feet per year. However, the firm yield for Lake Randell as calculated by the approved TCEQ Water Availability Model (modelled without backup supplies from Lake Texoma) is 1,400 acre-feet per year. Denison's actual use from Lake Randell is not limited by the firm yield required to be shown in this plan. Denison holds a water right from Lake Texoma for 24,400 acre-feet per year, and Denison has also an agreement to purchase an additional 12,204 acre-feet per year of Lake Texoma water from GTUA. Denison has an existing intake structure and pipeline that currently delivers water from Lake Texoma to Lake Randell. A treatment plant located near Lake Randell treats water from both Lake Randell and water delivered from Lake Texoma.

The amount of water currently available to Denison is partially limited by the capacity of its water treatment plant. Denison will need to develop up to 12 MGD of additional treatment capacity in order to meet its 2070 demands. Along with the water treatment expansions, Denison will also need to expand its current delivery infrastructure from Lake Texoma. Denison has designed an expanded pump station and pipeline capable of delivering all future supply from Lake Texoma, and construction of this infrastructure is slated for 2018.

Also, in the future, Denison may participate in the Grayson County Water Supply Project, which would necessitate additional treatment plant capacity and involve providing supplies to other Grayson County Water User Groups. Some additional treatment capacity has been incorporated into the future strategies for Denison. If in the future, additional treatment for the Grayson County Water Supply Project is necessary beyond what is shown in this plan, this additional treatment will be considered to be consistent with this plan for the purposes of permitting and/or TWDB financing. It is not clear how the participating entities will divide the development or the cost of the Grayson County Water Supply Project. For this plan, the costs (other than for Denison's and Sherman's treatment plant expansions) are shown under Greater Texoma Utility Authority.

The proposed future strategies for Denison are to implement water conservation measures, add water treatment plant capacity, and expand raw water delivery infrastructure from Lake Texoma. A summary of the recommended water plan for Denison is shown on Table 5C.34. Table 5C.35 shows the cost of Denison's recommended water management strategies.

Table 5C.34
Summary of Recommended Water Management Strategies for Denison

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Demand (Table H.8)	**8,139**	**8,942**	**9,687**	**10,499**	**12,106**	**14,720**
Existing Supplies						
*Lake Randell**	*1,400*	*1,400*	*1,400*	*1,400*	*1,400*	*1,400*
Lake Texoma (water right)	*24,400*	*24,400*	*24,400*	*24,400*	*24,400*	*24,400*
Lake Texoma (contracted with GTUA)	*12,204*	*12,204*	*12,204*	*12,204*	*12,204*	*12,204*
Woodbine Aquifer	*121*	*121*	*121*	*121*	*121*	*121*
Currently Available Supplies	***38,125***	***38,125***	***38,125***	***38,125***	***38,125***	***38,125***
Available Supplies Limited by WTP Capacity (7,278 af/y), plus Groundwater and Raw Water Manufacturing Demand	***8,144***	***8,207***	***8,267***	***8,318***	***8,396***	***8,480***
Need (Demand - Supply)	***0***	***736***	***1,421***	***2,182***	***3,711***	***6,241***
Water Management Strategies						

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Conservation (retail)	233	554	631	721	882	1,144
Conservation (customers)	3	7	22	31	35	38
Additional Lake Texoma with Infrastructure as follows:	0	2,242	2,242	2,242	4,484	6,726
4 MGD WTP Expansion		*2,242*	*2,242*	*2,242*	*2,242*	*2,242*
4 MGD New WTP					*2,242*	*2,242*
4 MGD WTP Expansion						*2,242*
Expand Raw Water Delivery from Lake Texoma		*2,242*	*2,242*	*2,242*	*4,484*	*6,726*
Total from Strategies	**236**	**2,803**	**2,895**	**2,994**	**5,401**	**7,908**
Total Supplies	**8,380**	**11,010**	**11,162**	**11,312**	**13,797**	**16,388**
Reserve or (Shortage)	**241**	**2,068**	**1,475**	**813**	**1,691**	**1,668**
Management Supply Factor	**1.03**	**1.23**	**1.15**	**1.08**	**1.14**	**1.11**

* Denison's water right amount in Lake Randell is 5,280 acre-feet per year. The amount shown in this table is the yield of Lake Randell as calculated by approved TCEQ Water Availability Model (modeled without Texoma Backup). Denison's actual use from Lake Randell is not limited by the amount shown in this table.

Table 5C.35
Summary of Costs for Denison Recommended Strategies

Strategy	Date to Be Developed	Quantity for Denison (Ac-Ft/Yr)	Denison Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	1,144	$322,613	$2.48	$0.91	Q-10
Conservation (customer)	2020	38	Included under County Summaries in Section 5D.			
4 MGD WTP Expansion	*2030*	2,242	$13,168,000	$2.15	$0.64	Q-13
4 MGD New WTP	*2060*	2,242	$19,888,000	$3.25	$0.97	Q-12
4 MGD WTP Expansion	*2070*	2,242	$13,168,000	$2.15	$0.64	Q-13
Expand Raw Water Delivery from Lake Texoma	*2030*	6,726	$21,629,700	$2.41	$0.29	Q-137
Total Denison Capital Costs			**$68,176,313**			

5C.2.6 City of Denton

The City of Denton currently provides treated water to its retail customers and manufacturing in Denton County. The city also provides treated wastewater effluent to irrigation users in Denton County. In the past, the city has provided treated wastewater effluent to a steam electric power facility located near its wastewater treatment plant. This power plant is currently mothballed, but could become operational at any time, so for the purpose of this Plan, the demands for this steam electric facility have been included.

The projected demands for Denton more than triple between 2020 and 2067. Denton's current sources of water supply include Ray Roberts Lake, Lewisville Lake, and direct and indirect reuse. Denton also has a contract to purchase raw water from Dallas Water Utilities (DWU). Denton's available supply in Ray Roberts Lake and Lewisville Lake is the city's share of the firm yield of the reservoirs. The yield of each reservoir decreases over time due to sedimentation. Denton's need in 2070 is over 74,000 acre-feet per year. The proposed future strategies for Denton are to implement water conservation measures, expand water treatment plant capacity, and purchase additional water from DWU. A summary of the recommended water plan for Denton is shown on Table 5C.36. Table 5C.37 shows the cost of Denton's recommended water management strategies.

Table 5C.36
Summary of Recommended Water Management Strategies for Denton

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.9)	**31,160**	**39,934**	**49,768**	**62,433**	**84,594**	**102,615**
Existing						
Lake Lewisville	*7,817*	*7,715*	*7,613*	*7,512*	*7,410*	*7,308*
Lake Ray Roberts	*18,902*	*18,733*	*18,564*	*18,395*	*18,226*	*18,057*
Direct Reuse (SEP)	*646*	*733*	*819*	*906*	*993*	*1,088*
Direct Reuse (IRR)	*406*	*406*	*406*	*406*	*406*	*406*
Indirect Reuse	*6,775*	*8,729*	*10,922*	*12,953*	*12,818*	*12,683*
Dallas Water Utilities	*0*	*2,301*	*7,735*	*14,433*	*27,839*	*37,545*
Available Supplies	***34,546***	***38,617***	***46,059***	***54,605***	***67,692***	***77,087***
Available Supplies Limited by Treatment Capacity	***27,956***	***28,043***	***28,129***	***28,216***	***28,303***	***28,398***
Need (Demand - Supply)	***3,204***	***11,891***	***21,639***	***34,217***	***56,291***	***74,217***
Water Management Strategies						
Conservation (retail)	530	956	1,410	1,981	2,984	3,966
Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Conservation (manufacturing, irrigation, SEP)	0	9	46	64	71	80
Add'l Supply with Treatment as below:	2,674	10,926	20,183	32,172	53,236	70,171
30 mgd Ray Roberts Plant Expansion	*2,674*	*10,926*	*16,815*	*16,815*	*16,815*	*16,815*
20 mgd Ray Roberts Plant Expansion			*3,368*	*11,210*	*11,210*	*11,210*
30 mgd Ray Roberts Plant Expansion				*4,147*	*16,815*	*16,815*
25 mgd Treatment Plant Expansion					*8,396*	*14,013*
25 mgd Treatment Plant Expansion						*11,318*

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Total from Strategies	**3,204**	**11,891**	**21,639**	**34,217**	**56,291**	**74,217**
Total Supplies	**31,160**	**39,934**	**49,768**	**62,433**	**84,594**	**102,615**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Additional DWU Supply		359	2,267	5,800	13,867	21,506
Total DWU Supply	0	2,660	10,002	20,233	41,706	59,051

Table 5C.37
Summary of Costs for Denton Recommended Strategies

Strategy	Date to Be Developed	Quantity for Denton (Ac-Ft/Yr)	Denton Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	3,966	$1,938,438	$2.16	$0.67	Q-10
Conservation (manf, irrigation, SEP)	2020	80	Included under County Summaries in Section 5D.			
30 mgd Ray Roberts Plant Expansion	2020	16,815	$59,881,000	$1.30	$0.39	Q-13
20 mgd Ray Roberts Plant Expansion	2040	11,210	$42,922,000	$1.40	$0.42	Q-13
30 mgd Ray Roberts Plant Expansion	2050	16,815	$59,881,000	$1.30	$0.39	Q-13
25 mgd Treatment Plant Expansion	2060	14,013	$51,402,000	$1.34	$0.40	Q-13
25 mgd Treatment Plant Expansion	2070	11,318	$51,402,000	$1.66	$0.50	Q-13
Total Denton Capital Costs			**$267,426,438**			

5C.2.7 East Cedar Creek Fresh Water Supply District

East Cedar Creek FWSD provides retail supplies to its service area, which includes all of Gun Barrel City and a portion of Payne Springs. The District previously only served a portion of Gun Barrel City (with Mabank serving the rest), but since the last Region C Plan the District has expanded its service area to the whole city.

East Cedar Creek FWSD obtains raw water from Tarrant Regional Water District (TRWD) and treats this water at its two water treatment plants (Brookshire WTP and McKay WTP). The recommended water management strategies for the District include implementing water conservation measures, purchasing additional water from TRWD, and increasing water treatment capacity. A summary of the recommended water management strategies for East Cedar Creek FWSD is shown on Table 5C.38. Table 5C.39 shows the cost of the water management strategies.

Table 5C.38
Summary of Recommended Water Management Strategies for East Cedar Creek FWSD

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.10)	**1,758**	**1,881**	**2,116**	**2,374**	**3,093**	**4,301**
Currently Available Supplies (Limited by Contract)						
TRWD (Cedar Creek)	*1,758*	*1,712*	*1,702*	*1,687*	*1,961*	*2,434*
Total Currently Available Supplies	***1,758***	***1,712***	***1,702***	***1,687***	***1,961***	***2,434***
Need (Demand - Supply)	**0**	**169**	**414**	**687**	**1,132**	**1,867**
Water Management Strategies						
Conservation (retail)	6	9	10	14	19	24
Conservation (wholesale)	9	13	13	18	34	64
Additional TRWD, with treatment expansion as follows:	0	147	391	655	1,079	1,779
Existing WTP (limit of 5.8 MGD, 3,251 af/y)	*0*	*147*	*391*	*655*	*1,079*	*817*
2 mgd Treatment Plant Expansion	*0*	*0*	*0*	*0*	*0*	*962*
Total Supplies from Strategies	**15**	**169**	**414**	**687**	**1,132**	**1,867**
Total Supplies	**1,773**	**1,881**	**2,116**	**2,374**	**3,093**	**4,301**
Reserve or (Shortage)	**15**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.01**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.39
Summary of Costs for East Cedar Creek FWSD Recommended Strategies

Strategy	**Date to be Developed**	**Quantity for ECCFWSD (Ac-Ft/Yr)**	**ECCWSD Share of Capital Costs**	**Unit Cost ($/1000 gal)**		**Table for Details**
				With Debt Service	**After Debt Service**	
Conservation (retail)	2020	24	$28,785	$1.23	$0.00	Q-10
Conservation (wholesale)	2020	64	Included under County Summaries in Section 5D.			
Additional TRWD	2030	1,779	$0	$0.97	$0.97	None
2 mgd Treatment Plant Expansion	2070	962	$8,904,000	$2.91	$0.87	Q-13
Total ECCFWSD Capital Costs			**$8,932,785**			

5C.2.8 City of Ennis

The current water supplies for the City of Ennis are Bardwell Lake (Trinity River Authority) and water purchased from Tarrant Regional Water District through the TRA as part of the Ellis County Water Supply Project. Ennis' contract amount from Bardwell is 5,200 acre-feet per year. Ennis' contract amount from the Ellis County Water Supply Project (TRWD/TRA) is 3,991 acre-feet per year. The city does not currently use the full contracted amount from TRWD, but the use is expected to increase over time up to the contracted amount. A few customers within the city of Ennis are provided retail water service by Rockett Special Utility District.

Ennis provides treated water to all or portions of: Community Water Company (Ellis County-Other), East Garrett WSC (Ellis County-Other), the town of Garrett, Rice WSC, Ellis County Steam Electric and Ellis County Manufacturing. Ennis also sells reclaimed water in Ellis County for steam electric power purposes. Ennis is expected to continue providing water supplies to these customers through the planning period. In the future Ennis intends to increase its use under the current contract with TRWD through TRA and to develop indirect reuse through Lake Bardwell in cooperation with TRA. The recommended water management strategies for Ennis include implementing water conservation measures, developing indirect reuse from Bardwell Lake, purchasing additional TRWD raw water through TRA as part of the Ellis County Water Supply Project, and expanding its water treatment plant.

A summary of the recommended water plan for Ennis is shown on Table 5C.40. The capital costs for the management strategies are shown on Table 5C.41. Costs for the Ellis County Water Supply Project (other than treatment plant expansions) are presented under the Trinity River Authority.

Table 5C.40
Summary of Recommended Water Management Strategies for Ennis

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.11)	**6,656**	**7,409**	**8,204**	**10,859**	**16,385**	**26,652**
Currently Available Supplies						
Bardwell Lake[(a)]	*5,200*	*5,035*	*4,801*	*4,567*	*4,333*	*4,296*
Direct Reuse (Steam Electric-Suez)	*909*	*909*	*909*	*909*	*909*	*909*
Contracted amount from TRWD (TRA)	*3,991*	*3,991*	*3,991*	*3,991*	*3,991*	*3,991*
Expected Use from TRWD (TRA)	*379*	*946*	*1,173*	*2,309*	*3,934*	*3,991*
Treated Water from Rockett for Retail	*12*	*9*	*8*	*6*	*5*	*3*
Total Currently Available Supplies with Expected Use from TRWD Limited by Water Treatment Plant Capacity	***6,500***	***6,899***	***6,891***	***7,641***	***7,640***	***7,638***

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Need (Supply - Demand)	***156***	***510***	***1,313***	***3,218***	***8,745***	***19,014***
Water Management Strategies						
Conservation (retail)	160	412	494	701	1,175	2,029
Conservation (wholesale customers)	8	14	24	41	67	146
Additional Rockett for Retail	5	8	9	11	12	14
Currently available TRWD (TRA) supply previously unused due to WTP Capacity limit				144	1,536	1,558
Indirect reuse			518	1,392	3,696	3,696
Additional TRWD (TRA)		93	285	940	2,271	11,585
Plant Expansions to Utilize Supply:						
6 MGD Expansion			*56*	*2,479*	*3,363*	*3,363*
8 MGD Expansion					*4,142*	*4,484*
16 MGD Expansion						*8,992*
Total Supplies from Strategies	**173**	**527**	**1,330**	**3,229**	**8,757**	**19,028**
Total Supplies	**6,673**	**7,426**	**8,221**	**10,870**	**16,397**	**26,666**
Reserve or (Shortage)	**17**	**17**	**17**	**11**	**12**	**14**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

(a) Ennis has a contract with the Trinity River Authority for 5,200 acre-feet per year. The yield of Bardwell is decreasing over time due to sedimentation, and Ennis' share of the reduced yield is shown here.

Table 5C.41
Summary of Costs for Ennis Recommended Strategies

Strategy	Date to be Developed	Quantity for Ennis (Ac-Ft/Yr)	Ennis Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	2,029	$119,838	$3.26	$1.28	Q-10
Conservation (wholesale)	2020	146	Included under County Summaries in Section 5D.			
Indirect Reuse	2040	3,696	$39,456,900	$4.22	$1.48	Q-108
Additional TRWD (TRA)	2030	13,143	$0	$0.97	$0.97	None
6 MGD Expansion	*2040*	*3,363*	$17,433,000	$1.90	$0.57	Q-13
8 MGD Expansion	*2060*	*4,484*	$21,697,000	$1.77	$0.53	Q-13
16 MGD Expansion	*2070*	*8,992*	$36,138,000	$1.47	$0.44	Q-13
Total Ennis Capital Costs			**$114,844,738**			

5C.2.9 City of Forney

The City of Forney currently purchases water from the North Texas Municipal Water District (NTMWD). Forney also purchases reuse water from Garland, which it then sells as a supply for Kaufman County Steam Electric Power. Forney currently supplies water to all or portions of: High Point WSC, McLendon-Chisholm (through High Point WSC), Talty WSC, the city of Talty (through Talty WSC), Kaufman County Other (Markout WSC), Kaufman County Manufacturing (through retail service within the city), and a Kaufman County Steam Electric provider. Demands on Forney are expected to almost double between 2020 and 2070, creating shortages of 564 acre-feet per year in 2020 which increase to 9,815 acre-feet per year by 2070. NTMWD plans to continue providing water to Forney and its retail customers. As NTMWD develops new water supply, Forney should have sufficient supplies. The recommended water management strategies for Forney include implementing water conservation measures and purchasing additional water from NTMWD.

A summary of the recommended water plan for Forney is shown in Table 5C.42, and the estimated costs for recommended water management strategies are summarized in Table 5C.43.

Table 5C.42
Summary of Recommended Water Management Strategies for Forney

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Demand (includes current reuse) (Table H.12)	**14,035**	**14,930**	**16,556**	**18,740**	**22,865**	**27,672**
Existing Supplies						
Garland Reuse (limited to demand)	*6,879*	*6,879*	*6,879*	*6,879*	*6,879*	*6,879*
NTMWD	*6,593*	*6,168*	*6,834*	*7,896*	*9,973*	*10,978*
Total Currently Available Supplies	***13,471***	***13,047***	***13,713***	***14,775***	***16,852***	***17,857***
Need (Demand - Supply)	**564**	**1,883**	**2,843**	**3,965**	**6,013**	**9,815**
Water Management Strategies						
Conservation (retail)	27	41	48	78	140	225
Conservation (wholesale)	33	53	83	127	178	251
Additional NTMWD	504	1,789	2,712	3,760	5,695	9,339
Increase delivery infrastructure from NTWMD (pump station)	*0*	*0*	*0*	*678*	*4,690*	*9,339*
Supplies from Strategies	**564**	**1,883**	**2,843**	**3,965**	**6,013**	**9,815**
Total Supplies	**14,035**	**14,930**	**16,556**	**18,740**	**22,865**	**27,672**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.43
Summary of Costs for Forney Recommended Strategies

Strategy	Date to be Developed	Quantity for Forney (Ac-Ft/Yr)	Forney Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	225	$308,348	$2.93	$0.00	Q-10
Conservation (wholesale)	2020	251	Included under County Summaries in Section 5D.			
Additional NTMWD	2020	9,339	$0	$1.70	$1.70	None
Increase delivery infrastructure from NTWMD (pump station)	*2050*	*9,339*	$11,162,800	$0.29	$0.12	Q-154
Total Forney Capital Costs			**$11,471,148**			

5C.2.10 City of Gainesville

The City of Gainesville currently provides treated water for its retail customers, Cooke County Other (municipal customers outside the city), as well as non-municipal uses in Cooke County (mining, manufacturing, and irrigation). The city also provides a small amount of direct reuse for irrigation. Gainesville is expected to become a regional provider, serving many water user groups in Cooke County. Bolivar Water Supply Corporation, Kiowa Homeowners WSC, Lindsay, Mountain Spring WSC, Valley View, and Woodbine Water Supply Corporation are all expected to get water from Gainesville in the future. As an alternative strategy, Muenster may also get water from Gainesville in the future. Gainesville currently obtains water from the Trinity aquifer and Moss Lake, and from a small amount of direct reuse. The yield of Moss Lake is 7,410 acre-feet per year, but the supply from Moss Lake is currently limited by treatment capacity of 2,242 acre-feet per year. Gainesville needs to develop an additional 5,022 acre-feet per year of supplies by 2070. Lake Moss yield is sufficient to meet this need for additional supplies. The recommended water management strategies to meet these needs include:

- Conservation
- Water Treatment Plant expansions
- Infrastructure to deliver treated water to new customer WUGs in Cooke County
- Additional direct reuse

These strategies are discussed individually below.

Conservation. Conservation is the projected conservation savings for Gainesville and its customers, based on the recommended Region C water conservation program. Not including savings from low-flow plumbing fixtures (already built into the projected demands) conservation is projected to reach 253 acre-feet per year by 2070.

Water Treatment Plant Expansions. Gainesville's yield from Lake Moss is 7,410 acre-feet per year, and in addition Gainesville has purchased a portion of GTUA's water supply from Lake Texoma and can utilize it in the future. With those two sources there is sufficient raw water supply to meet all future customer demands. However, the currently available supply is limited by Gainesville's water treatment plant capacity, at 2,242 acre-feet per year. Future expansions of treatment capacity (beginning in 2060) will enable Gainesville to meet customer demand. Along with future treatment expansions, Gainesville will need to increase its raw water delivery capacity from Lake Moss. The Lake Moss intake structure expansion and parallel pipeline have been included in the cost estimate.

Infrastructure to deliver treated water to new customer WUGs in Cooke County. Gainesville is expected to develop a network of infrastructure to deliver treated water to the customer WUGs listed in Appendix H. (In the 2011 Region C Plan, this strategy was referred to as the Cooke County Water Supply Project.) This network of infrastructure may be developed in coordination with Greater Texoma Utility Authority. It is not clear how the participating entities will divide the development or the cost of this new infrastructure. For this plan, the capital costs are included under Gainesville.

Additional Direct Reuse. Gainesville will develop additional direct reuse supplies to provide water for Cooke County Irrigation and Cooke County Mining.

An alternative strategy for Gainesville would be to construct an intake on Lake Texoma and a pipeline from the lake to a new water treatment plant.

Table 5C.44 shows the recommended water management strategies for the City of Gainesville. Table 5C.45 gives information on the capital and unit costs for the recommended water management strategies, and Table 5C.46 gives information on the capital and unit costs for the alternative water management strategy.

Table 5C.44
Recommended Water Management Strategies for Gainesville

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.14)	**3,605**	**3,302**	**3,268**	**3,676**	**5,129**	**9,377**
Currently Available Supplies						
Moss Lake (Treatment Capacity)	*2,242*	*2,242*	*2,242*	*2,242*	*2,242*	*2,242*
Direct Reuse	*9*	*9*	*9*	*9*	*9*	*9*
Trinity Aquifer	*2,104*	*2,104*	*2,104*	*2,104*	*2,104*	*2,104*

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Total Currently Available Supplies	***4,355***	***4,355***	***4,355***	***4,355***	***4,355***	***4,355***
Need (Demand - Current Supplies)	***0***	***0***	***0***	***0***	***774***	***5,022***
Water Management Strategies						
Conservation (retail)	21	30	27	37	56	93
Conservation (wholesale)	27	38	41	61	88	160
Additional Lake Moss with WTP Expansions as below:	0	0	0	0	560	4,699
2.5 MGD WTP Expansion					*560*	*1,401*
6 MGD WTP Expansion						*3,298*
Infrastructure to deliver to customers	*0*	*204*	*293*	*393*	*937*	*1,825*
Additional Direct Reuse	70	70	70	70	70	70
Total Supplies from Strategies	**118**	**138**	**138**	**168**	**774**	**5,022**
Total Supplies	**4,473**	**4,493**	**4,493**	**4,523**	**5,129**	**9,377**
Reserve or (Shortage)	**868**	**1,191**	**1,225**	**847**	**0**	**0**
Management Supply Factor	**1.24**	**1.36**	**1.37**	**1.23**	**1.00**	**1.00**

Table 5C.45
Summary of Costs for Gainesville Recommended Strategies

Strategy	Date to Be Developed	Quantity for Gainesville (Ac-Ft/Yr)	Gainesville Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	93	$225,921	$2.76	$0.00	Q-10
Conservation (wholesale)	2020	160	Included under County Summaries in Section 5D.			
Additional Lake Moss	2060	4,699	$0	$0.00	$0.00	None
2.5 MGD WTP Expansion	*2060*	*1,401*	$9,970,000	$2.61	$0.78	Q-13
6 MGD WTP Expansion	*2070*	*3,298*	$17,431,000	$1.94	$0.58	Q-13
Infrastructure to deliver to customers	*2020*	*1,825*	$26,296,000	$6.88	$3.18	Q-82
Additional Direct Reuse	2020	70	$1,669,000	$7.15	$1.05	Q-81
Total Gainesville Capital Costs			**$55,591,921**			

Table 5C.46
Summary of Costs for Gainesville Alternative Strategies

Strategy	Date to Be Developed	Quantity for Gainesville (Ac-Ft/Yr)	Gainesville Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Lake Texoma	2060	4,699	$77,941,000	$5.51	$1.25	Q-83
Total Gainesville Capital Costs			**$77,941,000**			

5C.2.11 City of Garland

The City of Garland currently purchases treated water from the North Texas Municipal Water District (NTMWD). Garland sells water for Dallas County Manufacturing and Collin County Steam Electric Power (Ray Olinger Power Plant). In the last plan, Garland was shown to sell water to Dallas County Steam Electric Power (CE Newman Plant), but that plant has since been demolished. The City of Garland sells some of its treated wastewater effluent to Forney for use for Kaufman County Steam Electric Power. Due to limits on the current supplies from NTMWD, Garland would have a projected shortage of 17,761 acre-feet per year by 2070 if NTMWD does not develop additional supplies. As NTMWD develops new water supplies, these shortages will be met. The recommended strategy for Garland is to implement water conservation measures. A summary of the recommended water plan for Garland is shown in Table 5C.47, and the estimated costs are in Table 5C.48.

Table 5C.47
Summary of Recommended Water Management Strategies for Garland

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.15)						
Treated Water (NTMWD)	41,272	41,710	41,487	41,305	41,265	41,314
Raw Water (Collin SEP - NTMWD)	715	602	740	594	782	724
Treated Effluent (Kaufman SEP to Forney)	8,979	8,979	8,979	8,979	8,979	8,979
Total	**50,966**	**51,291**	**51,206**	**50,878**	**51,026**	**51,017**
Currently Available Supplies						
NTMWD	*38,683*	*32,422*	*29,823*	*27,893*	*26,233*	*24,277*
Total Currently Available Treated Water Supplies	***38,683***	***32,422***	***29,823***	***27,893***	***26,233***	***24,277***
Need (Demand - Supply)*	***3,304***	***9,890***	***12,404***	***14,006***	***15,814***	***17,761***

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Conservation (retail)	694	1,013	375	495	617	741
Conservation (wholesale)	0	7	83	118	123	124
Additional NTMWD	2,610	8,870	11,946	13,393	15,074	16,896
Total Treated Water Supplies from Strategies	**3,304**	**9,890**	**12,404**	**14,006**	**15,814**	**17,761**
Total Treated Water Supplies	**41,987**	**42,312**	**42,227**	**41,899**	**42,047**	**42,038**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Reuse						
Demand (Kaufman Co SEP)	8,979	8,979	8,979	8,979	8,979	8,979
Currently Available Reuse Supply	8,979	8,979	8,979	8,979	8,979	8,979
Reuse Need (Reuse Demand – Reuse Supply)	**0**	**0**	**0**	**0**	**0**	**0**

Note: *Development of NTMWD water management strategies recommended in this plan will fully meet needs for Garland and other NTMWD customers.

Table 5C.48
Summary of Costs for Garland Recommended Strategies

Strategy	Date to be Developed	Quantity for Garland (Ac-Ft/Yr)	Garland Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	1,013	$2,352,502	$2.10	$0.00	Q-10
Conservation (wholesale)	2030	124	Included under County Summaries in Section 5D.			
Additional NTMWD	2020	16,896	$0	$1.70	$1.70	None
Total Garland Capital Costs			**$2,352,502**			

5C.2.12 City of Grand Prairie

The City of Grand Prairie does not currently have any wholesale customers, but the City has signed a contract to supply water to the Johnson County Special Utility District, which will make it a wholesale water provider. The City also provides water to Dallas County Irrigation and to both Tarrant and Dallas County Manufacturing entities. Grand Prairie currently gets most of its water from Dallas Water Utilities, with smaller supplies from Fort Worth, Midlothian, Mansfield, groundwater, and Joe Pool Lake (for irrigation). Grand Prairie is also investigating an Arlington supply. Water supply from Fort Worth and Mansfield obtain raw water from Tarrant Regional Water District (TRWD). Grand Prairie's water supply from Mansfield is assumed to be from Joe Pool Lake. All of these supplies will be implemented before 2020. Grand Prairie will also obtain additional supplies from Dallas. Grand Prairie's recommended water management strategies include the following:

- Conservation
- Connect to Arlington
- Additional supplies from Dallas, Fort Worth, and Mansfield.

A summary of the recommended water plan for Grand Prairie is shown in Table 5C.49, and the estimated costs are in Table 5C.50.

Table 5C.49
Summary of Recommended Water Management Strategies for Grand Prairie

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.16)	**43,648**	**49,316**	**52,715**	**52,506**	**52,484**	**52,520**
Currently Available Supplies						
Groundwater	*4,200*	*4,200*	*4,200*	*4,200*	*4,200*	*4,200*
Joe Pool Raw Water	*300*	*300*	*300*	*300*	*300*	*300*
Fort Worth (TRWD)	*2,752*	*2,260*	*1,916*	*1,725*	*1,579*	*1,451*
Midlothian	*3,363*	*3,363*	*3,363*	*3,363*	*3,363*	*3,363*
Mansfield	*3,363*	*3,363*	*3,363*	*3,146*	*2,841*	*2,573*
Dallas	*23,966*	*26,712*	*26,052*	*23,869*	*21,938*	*20,918*
Currently Available Supplies	***37,944***	***40,198***	***39,194***	***36,603***	***34,221***	***32,805***
Need (Demand - Supply)	***5,704***	***9,118***	***13,521***	***15,903***	***18,263***	***19,715***
Water Management Strategies						
Conservation (retail)	645	1,060	442	585	731	877
Conservation (wholesale)	1	13	50	68	75	80
Additional Dallas	719	3,274	7,252	9,105	10,344	11,282
Additional Fort Worth (TRWD)	0	495	831	1,016	1,159	1,286
Mansfield (TRWD)	3,240	3,188	3,296	3,490	3,773	4,018
Arlington (TRWD)	1,100	1,092	1,665	1,660	2,205	2,197
Total from Strategies	**5,705**	**9,122**	**13,536**	**15,924**	**18,287**	**19,740**
Total Supplies	**43,649**	**49,320**	**52,730**	**52,527**	**52,508**	**52,545**
Reserve or (Shortage)	**1**	**4**	**15**	**21**	**24**	**25**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Total DWU Supply	24,685	29,986	33,304	32,974	32,282	32,200
Total TRWD Supply	10,455	10,398	11,071	11,037	11,557	11,525
Other Supplies	8,509	8,936	8,355	8,516	8,669	8,820

Table 5C.50
Summary of Costs for Grand Prairie Recommended Strategies

Strategy	Date to Be Developed	Quantity for Grand Prairie (Ac-Ft/Yr)	Grand Prairie Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation	2020	1,060	$2,060,148	$2.08	$0.00	Q-10
Conservation (Wholesale)	2020	80	Included under County Summaries in Section 5D.			
Additional Dallas with additional pipeline	2020	11,282	$34,306,000	$0.96	$0.18	Q-88
Additional Fort Worth (TRWD)	2020	1,286	$0	$1.96	$1.96	None
Additional Mansfield (TRWD)	2020	4,018	$0	$2.50	$2.30	None
Connect to Arlington (TRWD)	2020	2,205	$4,950,500	$3.19	$2.61	Q-87
Total Grand Prairie Capital Costs			**$41,316,648**			

5C.2.13 Lake Cities Municipal Utility Authority

Lake Cities Municipal Utility Authority (MUA) currently serves and plans to continue serving water to Lake Dallas, Hickory Creek, and Shady Shores. The demands of these wholesale customers are expected to increase by over 35 percent over the planning period due to population growth in the Denton County area. The current supplies for Lake Cities MUA include groundwater from the Trinity aquifer and treated surface water purchased from the Upper Trinity Regional Water District (UTRWD). UTRWD will continue to provide water to Lake Cities MUA to meet the projected demands. The need for additional supplies identified for Lake Cities MUA is 1,529 acre-feet per year in 2070. The recommended water management strategies include implementing water conservation measures, purchasing additional water from UTRWD, and constructing additional infrastructure as needed to deliver water to wholesale customers. A summary of the recommended water plan for Lake Cities MUA is shown on Table 5C.51. The capital costs for infrastructure projects are shown on Table 5C.52.

Table 5C.51
Summary of Recommended Water Management Strategies for Lake Cities MUA

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Demand (Table H.18)	**2,140**	**2,406**	**2,715**	**2,915**	**2,909**	**2,908**
Currently Available						
Groundwater	*355*	*355*	*355*	*355*	*355*	*355*
Currently Available from UTRWD	*1,785*	*1,642*	*1,492*	*1,299*	*1,169*	*1,024*

Currently Available Supplies	***2,140***	***1,997***	***1,847***	***1,654***	***1,524***	***1,379***
Needs (Demands - Supplies)	**0**	**409**	**868**	**1,261**	**1,385**	**1,529**
Water Management Strategies						
Conservation	18	27	27	39	48	59
Additional UTRWD	0	417	912	1,330	1,479	1,612
Infrastructure to deliver to customers	*0*	*417*	*912*	*1,330*	*1,479*	*1,612*
Total from Strategies	**18**	**444**	**939**	**1,369**	**1,527**	**1,671**
Total Supplies	**2,158**	**2,441**	**2,786**	**3,023**	**3,051**	**3,050**
Reserve or (Shortage)	**18**	**35**	**71**	**108**	**142**	**142**
Management Supply Factor	**1.01**	**1.01**	**1.03**	**1.04**	**1.05**	**1.05**

Table 5C.52
Summary of Costs for Lake Cities MUA Recommended Strategies

Strategy	Date to be Developed	Quantity for Lake Cities MUA (Ac-Ft/Yr)	Lake Cities MUA Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation	2020	59*	Included under County Summaries in Section 5D.			
Additional UTRWD	2030	1,612	$0	$3.00	$3.00	None
Total Lake Cities MUA Capital Costs			**$0**			

* Lake Cities MUA has no retail sales, so conservation savings are reflected in their customers' conservation savings.

5C.2.14 City of Mansfield

The City of Mansfield currently purchases raw water from the Tarrant Regional Water District (TRWD), and has a 45 mgd water treatment plant. Mansfield sells water to Johnson County SUD and plans to continue selling to the SUD through the planning period. Mansfield also serves some manufacturing demands within the city through retail service. In the future, Mansfield plans to sell water to Grand Prairie as well. With the additional demands on the city, Mansfield has a projected need for additional supply of 40,709 acre-feet per year by 2070. The recommended water management strategies for Mansfield include implementing water conservation measures, purchasing additional water from the TRWD, and expanding its water treatment capacity. Mansfield's current Capital Improvements Program anticipates a 15 MGD water treatment expansion between 2016 and 2021, with two 20 MGD expansions as the City reaches buildout. An additional expansion is shown here to meet the demands shown in this plan. A summary of the recommended water plan for Mansfield is shown on Table 5C.53, and Table 5C.54 shows the estimated costs of the recommended strategies.

Table 5C.53
Summary of Recommended Water Management Strategies for Mansfield

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands (Table H.19)	**36,952**	**40,363**	**45,168**	**53,921**	**59,704**	**65,931**
Currently Available Supplies (Limited by Treatment Capacity and Yield)						
Available from TRWD	36,952	36,736	36,334	38,326	37,852	37,308
TRWD (Constrained by Treatment Plant Capacity)	25,223	25,223	25,223	25,223	25,223	25,223
Total Currently Available Supplies	***25,223***	***25,223***	***25,223***	***25,223***	***25,223***	***25,223***
Need (Demand - Supply)	***11,730***	***15,141***	***19,946***	***28,699***	***34,482***	***40,709***
Water Management Strategies						
Conservation (retail)	348	573	794	1,161	1,473	1,838
Conservation (wholesale customers)	127	183	84	114	139	166
Currently available TRWD supply previous unused due to WTP Capacity limit	11,730	11,513	11,112	13,104	12,629	12,086
Additional Raw Water from TRWD	0	2,871	7,956	14,320	20,240	26,619
Infrastructure to treat TRWD water above:						
15 MGD WTP Expansion	*8,408*	*8,408*	*8,408*	*8,408*	*8,408*	*8,408*
20 MGD WTP Expansion-1	*3,322*	*5,977*	*10,660*	*11,210*	*11,210*	*11,210*
20 MGD WTP Expansion-2				*7,806*	*11,210*	*11,210*
16 MGD WTP Expansion					*2,042*	*7,877*
Total Supplies from Strategies	**12,205**	**15,141**	**19,946**	**28,699**	**34,482**	**40,709**
Total Supplies	**37,427**	**40,363**	**45,168**	**53,921**	**59,704**	**65,931**
Reserve or (Shortage)	**475**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.01**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.54
Summary of Costs for Mansfield Recommended Strategies

Strategy	Date to be Developed	Quantity for Mansfield (Ac-Ft/Yr)	Mansfield Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	1,838	$2,320,683	$2.77	$0.57	Q-10
Conservation (wholesale customers)	2020	183	Included under County Summaries in Section 5D.			
Additional TRWD Supply	2020	38,705	$0	$0.97	$0.97	
15 MGD WTP Expansion	*2021*	*8,408*	$34,489,000	$1.50	$0.45	Q-13
20 MGD WTP Expansion-1	*2025*	*11,210*	$42,984,000	$1.40	$0.42	Q-13
20 MGD WTP Expansion-2	*2050*	*11,210*	$42,984,000	$1.40	$0.42	Q-13
16 MGD WTP Expansion	*2060*	*7,877*	$36,188,000	$1.48	$0.44	Q-13
Total Mansfield Capital Costs			**$158,965,683**			

5C.2.15 City of Midlothian

The City of Midlothian currently obtains water from the Trinity River Authority (TRA) supply in Joe Pool Lake and from TRA's supplies from TRWD. The City has two separate treatment facilities, with a plan for each source of supply. The City supplies water to Mountain Peak WSC, Rockett SUD, Venus (in Region G), Grand Prairie, Ellis County Manufacturing (retail supply within the city), and a portion of Ellis County Steam Electric Power (American National Power). Midlothian will need to develop 12,491 acre-feet per year of additional supply by 2070. The recommended water management strategies for Midlothian include implementing water conservation measures, additional purchases from TRA (TRWD sources), and water treatment plant expansion to use water purchased from TRA (TRWD sources). Two alternative strategies for Midlothian are purchasing Duncanville's unused portion of the yield of Lake Joe Pool (7.04% of the yield) and direct potable reuse of treated effluent from TRA's Mountain Creek Regional Wastewater System, beginning with 1,121 acre-feet per year (1 MGD) in 2020, and increasing to 5,605 acre-feet per year (5 MGD) in 2070. The purchase from Duncanville would not require any additional infrastructure because Midlothian's Tayman Drive Water Treatment Plant is sufficient to treat this additional supply. The direct potable reuse project would require a pipeline from the wastewater plant to the water treatment plant (approximately a quarter mile), additional treatment of the effluent, and an expansion of Midlothian's Auger Road Water Treatment Plant. A summary of the recommended water plan for Midlothian is shown on Table 5C.55. The capital costs of the recommended strategies for Midlothian are shown on Table 5C.56, and the capital costs of the alternative strategies for Midlothian are shown on Table 5C.57.

Table 5C.55
Summary of Recommended Water Management Strategies for Midlothian

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.20)	**12,253**	**14,020**	**16,282**	**18,532**	**20,748**	**22,765**
Currently Available Supplies (Limited by Yield or WTP)						
Joe Pool Lake (limited by yield)	*5,833*	*5,712*	*5,591*	*5,470*	*5,349*	*5,229*
TRA/TRWD (limited by WTP)	*4,870*	*5,045*	*5,045*	*5,045*	*5,045*	*5,045*
Total Currently Available Supplies	***10,703***	***10,757***	***10,636***	***10,515***	***10,394***	***10,274***
Need (Demand - Supply)	***1,550***	***3,263***	***5,646***	***8,017***	***10,354***	***12,491***
Water Management Strategies						
Conservation (retail)	96	192	285	378	473	560
Conservation (wholesale customers)	33	40	64	237	595	753
Additional TRA/TRWD with WTP Expansions as below:	1,421	3,031	5,297	7,402	9,286	11,178
Existing WTP capacity	*175*	*0*	*0*	*0*	*0*	*0*
6 MGD WTP Expansion-1	*1,184*	*2,978*	*3,363*	*3,363*	*3,363*	*3,363*
6 MGD WTP Expansion-2			*1,885*	*3,363*	*3,363*	*3,363*
6 MGD WTP Expansion-3					*2,511*	*3,363*
Total Supplies from Strategies	**1,550**	**3,263**	**5,646**	**8,017**	**10,354**	**12,491**
Total Supplies	**12,253**	**14,020**	**16,282**	**18,532**	**20,748**	**22,765**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Alternative Water Management Strategies						
Direct Potable Reuse (Mountain Creek WWTP effluent)	1,121	2,242	3,363	4,484	5,605	5,605
Purchase Duncanville's Joe Pool yield (up to 1 MGD)	1,048	1,026	1,004	983	961	939

Table 5C.56
Summary of Costs for Midlothian Recommended Strategies

Strategy	Date to be Developed	Quantity for Midlothian (Ac-Ft/Yr)	Midlothian Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	560	$531,705	$3.32	$1.01	Q-10
Conservation (wholesale)	2020	753	Included under County Summaries in Section 5D			
Additional TRWD	2020	11,718	$0	$0.97	$0.97	None
6 MGD WTP Expansion-1	*2020*	*3,363*	$17,433,000	$1.90	$0.57	Q-13
6 MGD WTP Expansion-2	*2040*	*3,363*	$17,433,000	$1.90	$0.57	Q-13
6 MGD WTP Expansion-3	*2060*	*3,363*	$17,433,000	$1.90	$0.57	Q-13
Total Midlothian Capital Costs			**$52,830,705**			

Table 5C.57
Summary of Costs for Midlothian Alternative Strategies

Strategy	Date to be Developed	Quantity for Midlothian (Ac-Ft/Yr)	Midlothian Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Direct Potable Reuse (Mountain Creek WWTP effluent)	2020	5,605	$52,417,600	$5.31	$2.91	Q-110
Purchase Duncanville's yield of Joe Pool (up to 1 MGD)	2020	1,048	$66,200	$1.11	$1.09	Q-111
Total Midlothian Capital Costs			**$52,483,800**			

5C.2.16 Mustang Special Utility District

Mustang Special Utility District (SUD), a wholesale water customer of Upper Trinity Regional Water District (UTRWD), provides retail water service to customers within its service area which includes Cross Roads, Krugerville, Oak Point, and a significant portion of unincorporated Denton County. In addition to providing retail service to its customers, Mustang SUD is the contract operator for several special districts that include the WUGs of Paloma Creek, Providence Village WCID, and Denton County FWSD #10. These special districts own their respective retail water systems and are wholesale water customers of UTRWD. Mustang SUD simply provides the general operational functions (billing, operations and maintenance, etc). Over time, the special districts will transfer ownership of the retail systems to Mustang SUD. The demands of these customers (both Mustang SUD and the special districts) are expected to almost triple over the planning period due to population growth in the Denton County area. The SUD is currently supplied from the Trinity and Woodbine aquifers and treated surface water purchased from UTRWD. Mustang SUD (including customers and special districts) has a projected need for 11,941 acre-feet per year of additional supplies in 2070. UTRWD plans to continue providing water to Mustang SUD, and projects developed by UTRWD will be able to supply the MUD's needs. The recommended water management strategies for Mustang SUD include implementing water conservation measures, purchasing additional water from the UTRWD, and developing infrastructure as needed to delivery water to customers. A summary of the recommended water plan for Mustang SUD is shown on Table 5C.58, and costs are summarized in Table 5C.59.

Table 5C.58
Summary of Recommended Water Management Strategies for Mustang SUD

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.21)	**7,182**	**12,154**	**14,554**	**16,837**	**19,056**	**20,723**
Existing Supplies						
Groundwater	*1,175*	*1,175*	*1,175*	*1,175*	*1,175*	*1,175*
Currently Available UTRWD	*6,007*	*8,734*	*8,357*	*7,800*	*7,957*	*7,607*
Currently Available Supplies	***7,182***	***9,909***	***9,532***	***8,975***	***9,132***	***8,782***
Needs (Demands - Supplies)	**0**	**2,245**	**5,022**	**7,862**	**9,924**	**11,941**
Water Management Strategies						
Conservation (retail)	16	33	52	91	142	204
Conservation (wholesale)	25	86	111	135	164	185
Additional UTRWD Supplies	0	2,243	5,092	7,991	10,088	12,022
Infrastructure to deliver water to customers	*0*	*2,243*	*5,092*	*7,991*	*10,088*	*12,022*
Total from Strategies	**41**	**2,362**	**5,255**	**8,217**	**10,394**	**12,411**
Total Supplies	**7,223**	**12,271**	**14,787**	**17,192**	**19,526**	**21,193**
Reserve or (Shortage)	**41**	**117**	**233**	**355**	**470**	**470**
Management Supply Factor	**1.01**	**1.01**	**1.02**	**1.02**	**1.02**	**1.02**

Table 5C.59
Summary of Costs for Mustang SUD Recommended Strategies

Strategy	Date to be Developed	Quantity for Mustang SUD (Ac-Ft/Yr)	Mustang SUD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	204	$186,398	$2.99	$0.00	Q-10
Conservation (wholesale)	2020	185	Included under County Summaries in Section 5D.			
Additional UTRWD Supplies	2030	12,022	$0	$3.00	$3.00	None
Infrastructure to deliver to customers	2030	12,022	$0	$0	$0	None
Total Mustang SUD Capital Costs			**$186,398**			

5C.2.17 City of North Richland Hills

The current water supplies for the City of North Richland Hills include water purchased from the City of Fort Worth (from the Tarrant Regional Water District) and water purchased from the Trinity River Authority (from the Tarrant Regional Water District). North Richland Hills sells water to Watauga and expects to continue supplying water to them in the future. North Richland Hills has a projected need for an additional 7,353 acre-feet per year by 2070. The proposed water management strategies for North Richland Hills are implementing water conservation measures, purchasing additional water from the Trinity River Authority (from TRWD), purchasing additional water from Fort Worth (from TRWD), and adding another pipeline to Fort Worth. A summary of the recommended water plan for North Richland Hills is shown in Table 5C.60, and the costs of the recommended strategies are shown in Table 5C.61.

Table 5C.60
Summary of Recommended Water Management Strategies for North Richland Hills

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.22)	**15,632**	**16,169**	**15,879**	**15,718**	**15,686**	**15,684**
Currently Available Supplies						
TRA (from TRWD)	*4,244*	*4,058*	*3,532*	*3,094*	*2,755*	*2,459*
Fort Worth (from TRWD)	*6,053*	*6,053*	*6,053*	*6,053*	*6,053*	*5,872*
Total Currently Available Supplies	***10,297***	***10,111***	***9,585***	***9,147***	***8,808***	***8,331***
Need (Demand - Supply)	***5,335***	***6,058***	***6,294***	***6,571***	***6,878***	***7,353***

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Conservation (retail)	233	353	395	435	478	521
Conservation (customers)	24	33	27	35	44	53
Additional TRA (from TRWD)	0	283	727	1,114	1,431	1,712
Additional Fort Worth (from TRWD)	5,078	5,390	5,145	4,987	4,925	5,067
New Pipeline from Fort Worth	*5,078*	*5,390*	*5,145*	*4,987*	*4,925*	*5,067*
Total Supplies from Strategies	**5,335**	**6,058**	**6,294**	**6,571**	**6,878**	**7,353**
Total Supplies	**15,632**	**16,169**	**15,879**	**15,718**	**15,686**	**15,684**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.61
Summary of Costs for North Richland Hills Recommended Strategies

Strategy	Date to be Developed	Quantity for NRH (Ac-Ft/Yr)	NRH Share of Capital Costs	Unit Cost ($/ 1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	521	$1,781,337	$3.57	$0.99	Q-10
Conservation (customers)	2020	53	Included under County Summaries in Section 5D.			
Additional TRA (from TRWD)	2020	1,712	$0	$2.90	$2.90	None
Additional Fort Worth (from TRWD)	2020	5,390	$0	$1.96	$1.96	None
New Pipeline from Fort Worth	*2020*	*5,390*	$8,091,833	$0.91	$0.12	Q-199
Total NRH Capital Costs			**$9,873,170**			

5C.2.18 City of Princeton

The City of Princeton supplies water to Culleoka Water Supply Corporation. Princeton obtains all of its water supplies from the North Texas Municipal Water District and plans to continue to do so. Table 5C.62 shows the recommended water management strategies for Princeton, and Table 5C.63 shows the costs for the recommended strategies.

Table 5C.62
Summary of Recommended Water Management Strategies for Princeton

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Demand (Table H.24)	**1,302**	**1,606**	**2,171**	**4,419**	**6,605**	**8,928**
Existing Supplies						
NTMWD	*1,200*	*1,231*	*1,533*	*2,942*	*4,121*	*5,156*
Total Currently Available Supplies	***1,200***	***1,231***	***1,533***	***2,942***	***4,121***	***5,156***
Need (Demand - Supply)	***102***	***375***	***638***	***1,477***	***2,484***	***3,772***
Water Management Strategies						
Conservation (retail)	8	13	16	49	97	158
Conservation (wholesale)	3	4	6	10	13	20
Additional NTMWD	91	358	616	1,418	2,374	3,594
Total Supplies from Strategies	**102**	**375**	**638**	**1,477**	**2,484**	**3,772**
Total Supplies	**1,302**	**1,606**	**2,171**	**4,419**	**6,605**	**8,928**
Surplus or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.63
Summary of Costs for Princeton Recommended Strategies

Strategy	Date to be Developed	Quantity for Princeton (Ac-Ft/Yr)	Princeton Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	158	$21,181	$0.68	$0.00	Q-10
Conservation (wholesale)	2020	20	Included under County Summaries in Section 5D.			
Additional NTMWD	2020	3,594	$0	$1.70	$1.70	None
Total Princeton Capital Costs			**$21,181**			

5C.2.19 Rockett Special Utility District

Rockett Special Utility District supplies water to a number of water user groups including: Palmer, Pecan Hill, Red Oak, Sardis-Lone Elm WSC, Ferris (including a large future development in Ferris' ETJ), Bardwell, and Ellis County Other (Boyce WSC, Bristol WSC). The SUD also provides small amounts of retail supplies within the city limits of a number of other cities in Ellis County (Ennis, Lancaster, Waxahachie, Oak Leaf). There is some potential that Rockett SUD may serve Buena Vista-Bethel SUD in the future, but it is more likely that Buena Vista-Bethel SUD will be supplied by other entities so it is not shown as a recommended strategy in this plan. It is shown as alternative strategy under Buena Vista-Bethel SUD in Section 5D.

The current supplies for Rockett SUD include treated water purchased from Midlothian and raw water purchased from the Trinity River Authority (TRA) through the Ellis County Water Supply Project. The source of the water purchased from TRA is Tarrant Regional Water District (TRWD), and this water is treated at Rockett SUD's Sokoll Water Treatment Plant. Rockett SUD jointly owns Sokoll WTP with the City of Waxahachie, with each party having 10 MGD capacity. The current supply from TRA (TRWD) shown on Table 5D.64 is limited by the contract amount (6,781 acre-feet per year) and further limited by the Rockett SUD's capacity at Sokoll Water Treatment Plant (5,605 acre-feet per year).

The recommended water management strategies for Rockett SUD include implementing water conservation measures, purchasing additional TRWD water from TRA, and increasing delivery infrastructure from Midlothian. As part of the Ellis County Water Supply Project, Rockett SUD will expand the Sokoll Water Treatment Plant to treat the additional raw water from TRWD through TRA. A summary of the recommended water plan for Rockett SUD is shown on Table 5C.64, and the costs for Rockett SUD are shown on Table 5C.65. Capital costs for the Ellis County Water Supply Project (other than treatment plant expansions) are shown in Table 5C.14 for TRA. It should be noted that the demand projections for Rockett SUD shown in this plan are somewhat lower than what Rockett projects in its current master planning work. Consequently, an amount greater than the demand has been allocated from TRWD (resulting in a "reserve" in this plan).

An alternative strategy for Rockett SUD would be to purchase treated water from Dallas, delivered through an existing 36" line that is located near the town of Red Oak. Rockett SUD would construct a 20" line to delivery this water into their system. This alternative strategy is also listed on Tables 5C.64 and 5C.65.

Table 5C.64
Summary of Recommended Water Management Strategies for Rockett SUD

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.25)	**11,093**	**13,139**	**15,547**	**17,707**	**21,584**	**28,888**
Currently Available Supplies						
Midlothian	*2,118*	*1,738*	*1,382*	*1,141*	*969*	*848*
TRWD through TRA	*6,781*	*6,781*	*6,781*	*6,781*	*6,781*	*6,781*
TRWD Limited by WTP Capacity	*5,605*	*5,605*	*5,605*	*5,605*	*5,605*	*5,605*
Total Currently Available Supplies	***7,723***	***7,343***	***6,987***	***6,746***	***6,574***	***6,453***

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Need (Demand - Supply)	***3,370***	***5,796***	***8,560***	***10,961***	***15,010***	***22,435***
Water Management Strategies						
Conservation (retail)	32	52	60	99	160	236
Conservation (wholesale customers)	94	156	212	273	343	456
Additional Midlothian with Infrastructure increase	124	504	860	1,101	1,273	1,394
Additional TRWD/TRA with Treatment as below:	4,934	7,303	10,124	12,610	16,996	24,899
Sokoll 10 MGD Expansion	*4,934*	*5,605*	*5,605*	*5,605*	*5,605*	*5,605*
Sokoll 10 MGD Expansion		*1,698*	*4,519*	*5,605*	*5,605*	*5,605*
Sokoll 10 MGD Expansion				*1,400*	*5,605*	*5,605*
Sokoll 10 MGD Expansion						*5,605*
Total Supplies from Strategies	**5,184**	**8,015**	**11,256**	**14,083**	**18,772**	**26,985**
Total Supplies	**12,907**	**15,358**	**18,243**	**20,829**	**25,346**	**33,438**
Reserve or (Shortage)	**1,814**	**2,219**	**2,696**	**3,122**	**3,762**	**4,550**
Management Supply Factor	**1.16**	**1.17**	**1.17**	**1.18**	**1.17**	**1.16**
Alternative Water Management Strategy						
Purchase treated water from Dallas with 20" transmission line	2,242	3,363	5,605	5,605	5,605	5,605

Table 5C.65
Summary of Costs for Rockett SUD Recommended Strategies

Strategy	Date to be Developed	Quantity for Rockett SUD (Ac-Ft/Yr)	Rockett SUD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2010	236	$500,000	$4.01	$0.00	Q-10
Conservation (wholesale)	2020	456	Included under County Summaries in Section 5D.			
Additional Midlothian with Infrastructure increase	2020	1,394	$11,874,000	$2.62	$0.43	Q-115
Additional TRWD/TRA	2020	24,899	$0	$0.97	$0.97	None
Sokoll 10 MGD Expansion	*2020*	*5,605*	$25,961,000	$1.70	$0.51	Q-13
Sokoll 10 MGD Expansion	*2030*	*5,605*	$25,961,000	$1.70	$0.51	Q-13
Sokoll 10 MGD Expansion	*2050*	*5,605*	$25,961,000	$1.70	$0.51	Q-13
Sokoll 10 MGD Expansion	*2070*	*5,605*	$25,961,000	$1.70	$0.51	Q-13
Total Rockett SUD Capital Costs			**$116,218,000**			

Table 5C.66
Summary of Costs for Rockett SUD Alternative Strategies

Strategy	Date to be Developed	Quantity for Rockett SUD (Ac-Ft/Yr)	Rockett SUD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Purchase treated water from Dallas with 20" transmission line	2020	5,605	$32,773,000	$1.69	$0.18	Q-116
Total Rockett SUD Capital Costs			**$32,773,000**			

5C.2.20 City of Rockwall

Rockwall's current water supply is water purchased from North Texas Municipal Water District (NTMWD). Rockwall sells water to Heath, Blackland WSC, Mt Zion WSC, McLendon-Chisholm (through R-C-H WSC), R-C-H WSC (part of Rockwall County-Other), portions of Rockwall County-Other, and Rockwall County Manufacturing. The recommended water management strategies for Rockwall are shown on Table 5C.67. The costs of these strategies are shown in Table 5C.68.

Table 5C.67
Summary of Recommended Water Management Strategies for Rockwall

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.26)	**14,693**	**20,885**	**23,543**	**26,270**	**30,447**	**34,678**
Existing Supplies						
NTMWD	*13,537*	*16,003*	*16,627*	*17,488*	*18,995*	*20,027*
Total Currently Available Supplies	***13,537***	***16,003***	***16,627***	***17,488***	***18,995***	***20,027***
Need (Demand - Supply)	***1,156***	***4,882***	***6,916***	***8,782***	***11,452***	***14,651***
Water Management Strategies						
Conservation (retail)	329	490	658	834	1,045	1,286
Conservation (wholesale)	78	217	263	289	327	375
Additional NTMWD	749	4,175	5,995	7,659	10,080	12,990
Infrastructure delivery infrastructure from NTWMD	*749*	*4,175*	*5,995*	*7,659*	*10,080*	*12,990*
Total Supplies from Strategies	**1,156**	**4,882**	**6,916**	**8,782**	**11,452**	**14,651**
Total Supplies	**14,693**	**20,885**	**23,543**	**26,270**	**30,447**	**34,678**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.68
Summary of Costs for Rockwall Recommended Strategies

Strategy	Date to be Developed	Quantity for Rockwall (Ac-Ft/Yr)	Rockwall Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	1,286	$409,483	$1.27	$0.62	Q-10
Conservation (wholesale)	2020	375	Included under County Summaries in Section 5D.			
Additional NTMWD	2020	12,990	$0	$1.70	$1.70	None
Infrastructure to delivery to customers	*2020*	*12,990*	$22,551,000	$0.56	$0.12	Q-183
Total Rockwall Capital Costs			**$22,960,483**			

5C.2.21 City of Seagoville

The City of Seagoville provides water to Combine WSC (now considered part of Dallas and Kaufman County Other) and to the City of Combine through Combine WSC. In the near future Seagoville will begin providing water to Gastonia-Scurry SUD. Seagoville currently obtains its water supply from Dallas Water Utilities (DWU) and plans to continue obtaining all of its water supply from DWU in the future. The recommended water management strategies for Seagoville are shown in Table 5C.69. The costs of these strategies are shown in Table 5C.70.

Table 5C.69
Summary of Recommended Water Management Strategies for Seagoville

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.27)	**2,819**	**3,237**	**3,775**	**4,440**	**5,887**	**7,603**
Existing Supplies						
DWU (limited by contract)	*1,682*	*1,682*	*1,682*	*1,682*	*1,682*	*1,682*
Total Currently Available Supplies	***1,682***	***1,682***	***1,682***	***1,682***	***1,682***	***1,682***
Need (Demand - Supply)	***1,138***	***1,556***	***2,094***	***2,759***	***4,206***	***5,922***
Water Management Strategies						
Conservation (retail)	17	26	28	42	60	71
Conservation (wholesale)	14	19	19	29	52	95
Additional DWU	1,107	1,511	2,047	2,688	4,094	5,756
Total Supplies from Strategies	**1,138**	**1,556**	**2,094**	**2,759**	**4,206**	**5,922**
Total Supplies	**2,819**	**3,237**	**3,775**	**4,440**	**5,887**	**7,603**

Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.70
Summary of Costs for Seagoville Recommended Strategies

Strategy	Date to be Developed	Quantity for Seagoville (Ac-Ft/Yr)	Seagoville Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	71	$76,397	$1.15	$0.00	Q-10
Conservation (wholesale)	2020	95	Included under County Summaries in Section 5D.			
Additional DWU	2020	5,756	$0	$1.48	$1.48	None
Total Seagoville Capital Costs			**$76,397**			

5C.2.22 City of Sherman

The City of Sherman provides water to Grayson County Steam Electric Power, Grayson County Manufacturing, Grayson County Other and Marilee Special Utility District. In the future, Sherman is expected to provide water for other water suppliers in Grayson County through the Grayson County Water Supply Project. Sherman uses groundwater from the Trinity and Woodbine Aquifers and water from Lake Texoma purchased from the Greater Texoma Utility Authority (GTUA) and treated at Sherman's desalination treatment plant. In the future, Sherman is expected to participate in the Grayson County Water Supply Project, which will include obtaining additional supplies from Lake Texoma, expanding Sherman's existing water treatment plant, developing and expanding a new desalination treatment plant, and providing supplies to other Grayson County Water User Groups. It should be noted that the 10 MGD water treatment plant expansion shown in the tables below in 2020 is already under design and construction should be completed in 2017. It is not clear how the participating entities will divide the development or the cost of the Grayson County Water Supply Project. For this plan, the costs (other than for Sherman's treatment plants) are shown under Greater Texoma Utility Authority.

The recommended water management strategies for Sherman are shown in Table 5C.71. The costs of these strategies are shown in Table 5C.72.

Table 5C.71
Recommended Water Management Strategies for Sherman

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands (Table H.28)	**22,932**	**23,758**	**25,710**	**27,994**	**33,405**	**42,898**
Treated Water Demand	*16,769*	*17,595*	*19,547*	*21,831*	*27,242*	*36,735*
Raw Water Demand (for SEP)	*6,163*	*6,163*	*6,163*	*6,163*	*6,163*	*6,163*
Currently Available Supplies						
Groundwater (Trinity)	*4,083*	*4,083*	*4,083*	*4,083*	*4,083*	*4,083*
Groundwater (Woodbine)	*1,289*	*1,289*	*1,289*	*1,289*	*1,289*	*1,289*
Greater Texoma Utility Authority (Lake Texoma, Treated, limited by WTP)	*11,210*	*11,210*	*11,210*	*11,210*	*11,210*	*11,210*
Greater Texoma Utility Authority (Lake Texoma, Treated, raw water supply for SEP)	*6,163*	*6,163*	*6,163*	*6,163*	*6,163*	*6,163*
Total Currently Available Treated Supplies (WTP limit + GW)	***16,582***	***16,582***	***16,582***	***16,582***	***16,582***	***16,582***
Total Currently Available Raw Supplies	***6,163***	***6,163***	***6,163***	***6,163***	***6,163***	***6,163***
Treated Need (Demand-Supply)	***187***	***1,013***	***2,965***	***5,249***	***10,660***	***20,153***
Raw Water Need (Demand-Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Conservation (retail)	193	288	358	458	650	992
Conservation (wholesale)	36	90	168	240	319	439
Grayson County WSP - Additional Texoma Supply from GTUA:	5,605	5,605	5,605	11,210	11,210	22,420
10 MGD WTP Expansion (desal)	*5,605*	*5,605*	*5,605*	*5,605*	*5,605*	*5,605*
10 MGD New WTP (desal)				*5,605*	*5,605*	*5,605*
20 MGD WTP Expansion (desal)						*11,210*
Total Supplies from Strategies	**5,834**	**5,983**	**6,131**	**11,908**	**12,179**	**23,851**
Total Supplies	**28,579**	**28,728**	**28,876**	**34,653**	**34,924**	**46,596**
Reserve (or Shortage)	**5,647**	**4,970**	**3,166**	**6,659**	**1,519**	**3,698**
Management Supply Factor	**1.25**	**1.21**	**1.12**	**1.24**	**1.05**	**1.09**

Table 5C.72
Summary of Costs for Sherman Recommended Strategies

Strategy	Date to be Devel-oped	Quantity for Sherman (Ac-Ft/Yr)	Sherman Share of Capital Costs	Unit Cost ($/ 1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	992	$1,044,775	$2.80	$0.86	Q-10
Conservation (wholesale)	2020	439	Included under County Summaries in Section 5D.			
Grayson County Water Supply Project:			Included under GTUA in Section 5C.1.			
10 MGD WTP Expansion (desal)	2020	5,605	$17,328,500	$2.82	$1.23	Q-13
10 MGD New WTP (desal)	2050	5,605	$34,657,000	$2.82	$1.23	Q-12
20 MGD WTP Expansion (desal)	2070	11,210	$29,478,000	$2.40	$1.05	Q-13
Total Sherman Capital Costs			**$82,508,275**			

5C.2.23 City of Terrell

The City of Terrell supplies water to College Mound WSC, High Point WSC, a portion of McLendon-Chisholm (though High Point WSC), Kaufman County Manufacturing, and a number of Water Supply Corporations and other suppliers included in Hunt County Other and Kaufman County Other. Terrell gets all of its water supplies from the North Texas Municipal Water District and plans to continue to obtain treated water from NTMWD through the planning period. The supply currently available to Terrell is limited to their contracted amount with NTWMD (6,726 acre-feet per year). As shown in Table 5C.73, the recommended water management strategies for Terrell include implementing water conservation measures, purchasing treated water from NTMWD (increasing contract amounts as needed in the future), and constructing facilities to take water from NTMWD and to deliver water to Terrell's customers. The costs for these recommended strategies are shown on Table 5C.74.

Table 5C.73
Summary of Recommended Water Management Strategies for Terrell

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Demand (Table H.30)	**5,336**	**8,721**	**10,778**	**13,693**	**17,152**	**20,965**
Existing Supplies						
NTMWD	*4,915*	*6,682*	*6,726*	*6,726*	*6,726*	*6,726*
Total Currently Available Supplies	***4,915***	***6,682***	***6,726***	***6,726***	***6,726***	***6,726***
Need (Demand - Supply)	**421**	**2,039**	**4,052**	**6,967**	**10,426**	**14,239**

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Conservation (retail)	74	175	259	356	454	574
Conservation (wholesale)	7	10	17	24	36	49
Additional NTMWD with Infrastructure as below:	340	1,854	3,776	6,587	9,936	13,616
Infrastructure Upgrades to Deliver water to Wholesale Customers	*340*	*1,854*	*3,776*	*6,587*	*9,936*	*13,616*
Additional Connection to NTMWD	*340*	*1,854*	*3,776*	*6,587*	*9,936*	*13,616*
Total Supplies from Strategies	**421**	**2,039**	**4,052**	**6,967**	**10,426**	**14,239**
Total Supplies	**5,336**	**8,721**	**10,778**	**13,693**	**17,152**	**20,965**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.74
Summary of Costs for Terrell Recommended Strategies

Strategy	Date to be Developed	Quantity for Terrell (Ac-Ft/Yr)	Terrell Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	574	$132,163	$2.93	$1.22	Q-10
Conservation (wholesale)	2020	49	Included under County Summaries in Section 5D.			
Additional NTMWD	2020	13,616	$0	$1.75	$1.75	None
Infrastructure Upgrades to Deliver water to Wholesale Customers	2020	11,210	$3,714,000	$1.89	$1.80	Q-157
	2030	2,803	$1,569,100	$1.94	$1.80	Q-158
	2040	4,484	$1,514,500	$1.88	$1.79	Q-159
	2040	4,484	$4,418,700	$2.06	$1.81	Q-160
	2020	6,726	$1,395,100	$1.84	$1.79	Q-161
	2030	4,484	$5,688,500	$2.16	$1.84	Q-162
Additional Connection to NTMWD	2040	13,452	$25,559,100	$2.38	$1.89	Q-163
Total Terrell Capital Costs			**$43,991,163**			

5C.2.24 Walnut Creek Special Utility District (SUD)

Walnut Creek Special Utility District (SUD) purchases raw water from Tarrant Regional Water District (TRWD) out of Lake Bridgeport and provides treated water to its own retail customers and to suppliers in Parker and Wise Counties. Its current wholesale customers include Boyd, Reno, Rhome, Aurora, and West Wise Rural SUD. Walnut Creek SUD also provides retail service to the portions of Parker and Wise County Other (including residents of Paradise and Sanctuary). Before 2020, the SUD may provide treated water to Newark and New Fairfield (both through Rhome) and to the town of Perrin (Jack County Other). To meet the projected demands Walnut Creek SUD will need to purchase more water from TRWD and develop additional treatment capacity (beyond the current 8 MGD). The recommended water management strategies for Walnut Creek SUD include implementing water conservation measures, purchasing additional water from TRWD, expanding their current water treatment facilities, constructing new treatment facilities, and other infrastructure to deliver water to customers. Table 5C.75 shows the recommended plan for Walnut Creek SUD. Table 5C.76 shows the capital and unit costs for the recommended strategies.

Table 5C.75
Summary of Recommended Water Management Strategies
for Walnut Creek Special Utility District

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.33)	**2,627**	**3,210**	**3,982**	**5,482**	**7,952**	**10,410**
Currently Available Supplies						
TRWD	*2,627*	*2,922*	*3,203*	*3,897*	*4,480*	*4,480*
Total Currently Available Supplies	***2,627***	***2,922***	***3,203***	***3,897***	***4,480***	***4,480***
Need (Demand - Supply)	**0**	**288**	**779**	**1,585**	**3,472**	**5,930**
Water Management Strategies						
Conservation (retail)	15	22	24	40	75	117
Conservation (wholesale)	25	49	68	70	106	151
Additional TRWD with infrastructure below:	0	218	686	1,476	3,291	5,662
New 6 MGD WTP	*0*	*218*	*686*	*1,476*	*3,291*	*3,363*
New 12 MGD Eagle Mountain WTP						*2,299*
Infrastructure to deliver to customers	*0*	*218*	*686*	*1,476*	*3,291*	*5,662*
Total Supplies from Strategies	**40**	**288**	**779**	**1,585**	**3,472**	**5,930**
Total Supplies	**2,667**	**3,210**	**3,982**	**5,482**	**7,952**	**10,410**
Surplus or (Shortage)	**40**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.02**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table5C.76
Summary of Costs for Walnut Creek SUD Recommended Strategies

Strategy	Date to be Developed	Quantity for Walnut Creek SUD (Ac-Ft/Yr)	Walnut Ck. SUD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	117	$75,798	$1.30	$0.00	Q-10
Conservation (wholesale)	2020	151	Included under County Summaries in Section 5D.			
Additional TRWD	2030	5,662	$0	$0.97	$0.97	None
New 6 MGD WTP	*2030*	*3,363*	$9,245,000	$1.64	$0.93	Q-12
New 12 MGD Eagle Mt WTP	*2070*	*2,299*	$53,337,000	$2.91	$0.87	Q-12
Total Walnut Creek SUD Capital Costs			**$62,657,798**			

5C.2.25 Waxahachie

The City of Waxahachie provides water to Buena Vista-Bethel SUD, Ellis County Other (small water supply corporations), and Ellis County Manufacturing. Potential future customers include Italy, Maypearl, Files Valley WSC, and Ellis County Steam Electric Power. Waxahachie obtains its current water supply from the following sources:

- Lake Waxahachie
- Bardwell Lake (by contract with TRA)
- Indirect reuse from Bardwell Lake (by contract with TRA)
- Supplies from Rockett SUD to retail connections in Waxahachie
- Water from TRWD through TRA treated at the Sokoll Water Treatment Plant, a joint project of Rockett SUD and Waxahachie.

Waxahachie's recommended strategies to meet its needs include:

- Conservation
- Dredging of Lake Waxahachie
- Additional water from TRWD through TRA for the Sokoll and Howard Road water treatment plants.
- Multiple expansions of the Howard Road Water Treatment Plant
- Raw water transmission for Ellis County Steam Electric Power
- Multiple infrastructure projects needed to take delivery of water from TRWD and delivery water to customers:
- New 36" Raw Water line from TRWDs' new Integrated Pipeline (IPL) to Lake Waxahachie

- New 27" Raw Water line from TRWDs' new Integrated Pipeline (IPL) to Howard Road Water Treatment Plant
- New 36" Raw Water line from Lake Waxahachie to Howard Road Water Treatment Plant
- Phase I Delivery Infrastructure to Customers in South Ellis County
- Phase II Delivery Infrastructure to Customers in South Ellis County
- Parallel Raw water supply line (48") from TRWD's existing East Texas pipeline to Sokoll Water Treatment Plant
- Increase raw water delivery infrastructure to Sokoll Water Treatment Plant
- Raw Water Intake Improvements at Lake Bardwell.

These strategies are discussed individually below.

Conservation. Conservation is the projected conservation savings for Waxahachie and its customers, based on the recommended Region C water conservation program. Not including savings from low-flow plumbing fixtures (which amount to about 5 percent of demand and are built into demand projections) and not including reuse, conservation by Waxahachie and its customers is projected to reach 1,152 acre-feet per year by 2070.

Dredging of Lake Waxahachie. This dredging project will enable Waxahachie to gain back yield that has been lost due to sedimentation. This quantity of yield that is expected to be gained back is equivalent to the difference in original yield (with no sedimentation) and the 2030 yield (calculated for sedimentation over time).

Additional TRWD – Ellis County Water Supply Project. As part of the Ellis County Water Supply Project, Waxahachie will continue to obtain raw water from TRWD through TRA for treatment at the Sokoll Water Treatment Plant and in the future will obtain raw water from TRWD through TRA for treatment at the Howard Road Water Treatment Plant.

Howard Road Plant Expansions – Ellis County Water Supply Project. As part of the Ellis County Water Supply Project, Waxahachie will expand the Howard Road Water Treatment Plant as additional raw water supply is obtained from TRWD through TRA. This water will be supplied from TRWD's new Integrated Pipeline, the route of which is in very close proximity to Lake Waxahachie. Expansions of this plant will also help to serve future customers in South Ellis County.

Raw Water Transmission for Ellis County Steam Electric Power. Waxahachie is expected to supply water for steam electric power generation in Ellis County. The cost of the facilities is based on an assumed pipeline length of 10 miles, but the actual length may vary, depending on the location of the future power plant.

New 36" Raw Water line from TRWDs' new Integrated Pipeline (IPL) to Lake Waxahachie. This new raw water line will enable Waxahachie to take TRWD water and store it in Lake Waxahachie as needed.

New 27" Raw Water line from TRWDs' new Integrated Pipeline (IPL) to Howard Road Water Treatment Plant. This new raw water line will enable Waxahachie to take TRWD water directly to the Howard Road treatment plant as needed.

New 36" Raw Water line from Lake Waxahachie to Howard Road Water Treatment Plant. This new raw water line will enable Waxahachie to take TRWD water that has been stored in Lake Waxahachie to the Howard Road Water Treatment Plant as needed.

Phase I and II Delivery Infrastructure to Customers in South Ellis County. Waxahachie anticipates serving multiple wholesale customers in southern Ellis County through a joint delivery system. These entities include Italy, Maypearl, Files Valley WSC, Ellis County Other (namely Nash-Forreston WSC, Avalon WSC, and South Ellis WSC), and additional portions of Buena Vista-Bethel SUD. An initial system is anticipated to be constructed by 2030, with an expansion in 2050 as demands grow.

Parallel Raw water supply line from TRWD's existing East Texas pipeline to Sokoll Water Treatment Plant. This new 48" line will parallel the existing line and increase delivery capacity from TRWD.

Increase raw water delivery infrastructure to Sokoll Water Treatment Plant. This 30" Raw water line will increase Waxahachie's capacity to delivery raw water from Lake Waxahachie or from Howard Road Water Treatment Plant to the Sokoll Water Treatment Plant which is jointly operates with Rockett SUD.

Raw Water Intake Improvements at Lake Bardwell. Waxahachie's intake at Lake Bardwell requires improvements in order to use the city's full supply from the lake.

Table 5C.77 shows the recommended water management strategies for the City of Waxahachie. Table 5C.78 gives information on the capital and unit costs for the recommended water management strategies.

Table 5C.77
Summary of Recommended Water Management Strategies for Waxahachie

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.34)	**10,649**	**11,682**	**15,756**	**20,480**	**24,612**	**29,455**
Currently Available Supplies						
Rockett SUD Supplies (for Rockett Retail Connections)	*427*	*343*	*275*	*234*	*187*	*137*
Lake Bardwell	*4,320*	*4,183*	*3,989*	*3,794*	*3,600*	*3,569*
Lake Waxahachie	*2,800*	*2,695*	*2,590*	*2,485*	*2,380*	*2,275*
Reuse (diverted from Lk Bardwell)	*3,479*	*3,882*	*4,614*	*5,129*	*5,129*	*5,129*
TRWD through TRA for Sokoll WTP	*2,500*	*2,275*	*2,011*	*4,419*	*5,212*	*5,212*
Total Current Supply	***13,526***	***13,378***	***13,479***	***16,061***	***16,508***	***16,322***
Current TRWD Supply limited by Sokoll Plant Capacity (10 mgd)	***2,500***	***2,275***	***2,011***	***4,419***	***5,212***	***5,212***
Current Other Supply limited by Howard Road Plant Capacity (18 mgd), plus treated from Rockett SUD	**10,516**	**10,432**	**10,364**	**10,323**	**10,276**	**10,226**
Total Current Supply limited by WTP	**13,016**	**12,707**	**12,375**	**14,742**	**15,488**	**15,438**
Need (Demand - Supply)	**0**	**0**	**3,381**	**5,738**	**9,124**	**14,017**
Water Management Strategies						
Conservation (retail)	130	211	292	392	525	695
Conservation (wholesale customers)	33	55	92	158	273	457
Add'l Rockett SUD for retail	186	270	338	379	426	476
Dredge Lake Waxahachie		705	705	705	705	705
Add'l TRA/TRWD water with infrastructure below:			2,659	4,809	7,900	12,389
Ellis County Steam Electric Supply Project			*2,116*	*4,129*	*4,484*	*4,484*
8 MGD Expansion Howard Rd WTP		*4,484*	*4,484*	*4,484*	*4,484*	*4,484*
10 MGD Expansion of Howard Rd WTP				*5,605*	*5,605*	*5,605*
12 MGD Expansion of Howard Rd WTP						*6,726*
36" Raw water line from IPL to Lake Waxahachie		*4,484*	*4,484*	*10,089*	*10,089*	*16,815*
27" Raw water line from IPL to Howard Road Water Treatment Plant		*4,484*	*4,484*	*10,089*	*10,089*	*16,815*
36" Raw water line from Lake Waxahachie to Howard Rd WTP		*4,484*	*4,484*	*10,089*	*10,089*	*16,815*
Phase I Delivery Infrastructure to Customers in South Ellis County		*281*	*1,121*	*1,121*	*1,121*	*1,121*
Phase II Delivery Infrastructure to Customers in South Ellis County		*0*	*1,638*	*4,105*	*5,165*	*5,875*

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
48" TRWD Parallel Supply Line to Sokoll WTP		*4,484*	*4,484*	*10,089*	*10,089*	*16,815*
Increase delivery infrastructure to Rockett SUD (30" Raw water Line)		*4,484*	*4,484*	*10,089*	*10,089*	*16,815*
Raw Water Intake Improvements at Lake Bardwell		*4,484*	*4,484*	*10,089*	*10,089*	*16,815*
Total Supplies from Strategies	**349**	**1,241**	**4,086**	**6,443**	**9,829**	**14,722**
Total Supplies	**13,365**	**13,948**	**16,461**	**21,185**	**25,317**	**30,160**
Reserve or (Shortage)	**2,716**	**2,266**	**705**	**705**	**705**	**705**
Management Supply Factor	**1.26**	**1.19**	**1.04**	**1.03**	**1.03**	**1.02**

Table 5C.78
Summary of Costs for Waxahachie Recommended Strategies

Strategy	Date to be Developed	Quantity for Waxahachie (Ac-Ft/Yr)	Waxahachie Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	695	$1,500,000	$5.21	$1.28	Q-10
Conservation (wholesale customers)	2020	457	Included under County Summaries in Section 5D.			
Dredge Lake Waxahachie	2030	705	$31,973,500	$11.65	N/A	Q-123
Add'l TRA/TRWD	2040	12,389	$0	$1.09	$1.09	None
Ellis County Steam Electric Supply Project	*2040*	*4,484*	$15,009,000	$1.05	$0.19	Q-107
8 MGD Expansion Howard Rd WTP	*2030*	*4,484*	$21,697,000	$1.77	$0.53	Q-13
10 MGD Expansion Howard Rd WTP	*2050*	*5,605*	$25,961,000	$1.70	$0.51	Q-13
12 MGD Expansion Howard Rd WTP	*2070*	*6,726*	$29,353,000	$1.60	$0.48	Q-13
36" Raw water line from IPL to Lake Waxahachie	*2030*	*16,815*	$1,073,400	$1.00	$0.97	Q-120
27" Raw water line from IPL to Howard Road Water Treatment Plant	*2030*	*16,815*	$3,176,400	$1.14	$0.99	Q-119
36" Raw water line from Lake Waxahachie to Howard Rd WTP	*2030*	*16,815*	$5,465,000	$0.15	$0.02	Q-121
Phase I Delivery Infrastructure to Customers in South Ellis County	*2030*	*1,121*	$15,220,700	$1.71	$0.24	Q-125
Phase II Delivery Infrastructure to Customers in South Ellis County	*2050*	*5,875*	$23,452,400	$1.75	$0.20	Q-126

Strategy	Date to be Developed	Quantity for Waxahachie (Ac-Ft/Yr)	Waxahachie Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
48" TRWD Parallel Supply Line to Sokoll WTP	*2030*	*16,815*	$3,510,500	$1.01	$0.97	Q-122
Increase delivery infrastructure to Rockett SUD (30" Raw water Line)	*2030*	*16,815*	$11,894,900	$0.50	$0.05	Q-124
Raw Water Intake Improvements at Lake Bardwell	*2030*	*16,815*	$5,168,200	$0.16	$0.08	Q-127
Total Waxahachie Capital Costs			**$194,455,000**			

5C.2.26 City of Weatherford

The City of Weatherford provides municipal, manufacturing, and irrigation water to users in Parker County. Weatherford currently provides water to the city of Hudson Oaks, and plans to potentially serve the cities of Annetta, Annetta North, Annetta South, Willow Park, and much of Parker County Other in the future. Weatherford also provides a small amount of water from Lake Weatherford for steam electric power (Brazos Electric Co-Op).

Weatherford's water supply consists of water the city has rights to use out of Lake Weatherford and Benbrook Lake (through its Sunshine Lake water right and a contract agreement with TRWD) and raw water the city purchases from Tarrant Regional Water District out of Lake Benbrook. (In the tables presented in this plan, Weatherford's Lake Benbrook supply has been included with the TRWD supply because both of those supplies come from the same reservoir.) The currently available supplies for Weatherford are limited to 7,860 acre-feet per year, which is 7,847 acre-feet per year of treatment plant capacity (14 MGD peak) plus the 13 acre-feet per year of raw water use for irrigation demand. To fully utilize its existing water rights and contracts, Weatherford will need to expand its water treatment plant capacity and expand the pumping capacity of the pipeline from Benbrook Lake. Weatherford is also currently developing a reuse project for their water from Lake Weatherford and Sunshine Lake. The recommended water management strategies for Weatherford include implementing water conservation measures, developing an indirect reuse project, purchasing additional water from the TRWD, increasing treatment capacity (new plant and expansions), and increasing transmission pump capacity from Benbrook Lake. Table 5C.79 shows the recommended water management strategies for Weatherford. Table 5C.80 shows the costs of the strategies.

Table 5C.79
Summary of Recommended Water Management Strategies for Weatherford

Planned Supplies (Ac-Ft/Yr)	2020	2030	2040	2050	2060	2070
Projected Demands (Table H.35)	**6,340**	**7,589**	**9,009**	**15,444**	**23,829**	**34,478**
Currently Available Supplies						
Lake Weatherford	*2,923*	*2,880*	*2,837*	*2,793*	*2,750*	*2,707*
TRWD	*1,162*	*2,077*	*2,862*	*5,826*	*8,824*	*8,770*
Current Supply	***4,085***	***4,957***	***5,699***	***8,619***	***11,574***	***11,477***
Current Supply Limited by Plant Capacity (14 mgd)	***4,085***	***4,957***	***5,699***	***7,860***	***7,860***	***7,860***
Need (Demand - Supply)	**2,255**	**2,632**	**3,310**	**7,584**	**15,969**	**26,618**
Water Management Strategies						
Conservation (retail)	141	299	385	676	1,134	1,756
Conservation (wholesale customers)	21	38	57	79	105	136
Indirect Reuse - Lake Weatherford/Sunshine	2,240	2,240	2,240	2,240	2,240	2,240
Add'l Water from TRWD	0	55	628	4,589	12,490	22,486
Treatment Plant & Infrastructure needed to treat and deliver TRWD and reuse water as below:						
14 MGD Existing WTP	*1,093*	*1,295*	*1,148*	*0*	*0*	*0*
8 MGD WTP Expansion	*1,000*	*1,000*	*1,000*	*4,484*	*4,484*	*4,484*
14 MGD New WTP				*2,345*	*7,847*	*7,847*
24 MGD WTP Expansion						*12,395*
Expand Lake Benbrook PS						
Total Supplies from Strategies	**2,402**	**2,632**	**3,310**	**7,584**	**15,969**	**26,618**
Total Supplies	**6,487**	**7,589**	**9,009**	**15,444**	**23,829**	**34,478**
Reserve or (Shortage)	**147**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.02**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.80
Summary of Costs for Weatherford Recommended Strategies

Strategy	Date to be Developed	Quantity for Weatherford (Ac-Ft/Yr)	Weatherford Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (retail)	2020	1,756	$3,295,000	$10.25	$2.05	Q-10
Conservation (wholesale customers)	2020	136	Included under County Summaries in Section 5D.			
Indirect Reuse - Lake Weatherford	2020	2,240	$13,089,000	$1.78	$0.28	Q-177
Add'l Water from TRWD	2030	22,486	$0	$0.97	$0.97	None
8 MGD WTP Expansion	*2040*	*4,484*	$36,408,000	$3.15	$1.06	Q-13
14 MGD New WTP	*2060*	*7,847*	$60,521,000	$2.83	$0.85	Q-12
24 MGD WTP Expansion	*2070*	*12,395*	$49,781,000	$1.47	$0.44	Q-13
Expand Lake Benbrook PS	*2030*		$2,301,800	$2.32	$1.00	Q-178
Total Weatherford Capital Costs			**$165,395,800**			

5C.2.27 West Cedar Creek Municipal Utility District

West Cedar Creek Municipal Utility District purchases raw water from the Tarrant Regional Water District (TRWD). West Cedar Creek MUD currently provides retail water service to customers within its service area and residents of the cities of Seven Points and Tool. WCCMUD plans to continue selling water to these entities in the future. Since the last regional plan was published, WCCMUD has taken over the water supply system for the City of Kemp, including Kemp's contract with TRWD. WCCMUD plans to continue operation of Kemp's system in the future.

The current supplies to West Cedar Creek MUD are limited by the contracted amount of 1.98 MGD (1.44 MGD for WCCMUD and 0.54 MGD for Kemp), or 2,220 acre-feet per year. The recommended water management strategies include implementing water conservation measures, purchasing additional water from the TRWD (increasing contract amounts as needed in the future), expanding water treatment capacity, expansion of intake and delivery infrastructure from Cedar Creek Lake, and expansion of delivery infrastructure to customers. Table 5C.81 shows the recommended water management strategies for the West Cedar Creek MUD. Table 5C.82 shows the costs of the strategies.

Table 5C.81
Summary of Recommended Water Management Strategies for West Cedar Creek MUD

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.36)	**2,542**	**2,859**	**3,209**	**3,681**	**4,934**	**6,652**
Currently Available Supplies						
TRWD (limited by contract)	*2,220*	*2,220*	*2,220*	*2,220*	*2,220*	*2,220*
Current Supply	***2,220***	***2,220***	***2,220***	***2,220***	***2,220***	***2,220***
Need (Demand - Supply)	**322**	**639**	**989**	**1,461**	**2,714**	**4,432**
Water Management Strategies						
Conservation (retail)	11	17	17	25	40	67
Conservation (wholesale customers)	28	56	70	90	137	195
Additional TRWD with Contract Increase and Infrastructure as below:	283	566	902	1,346	2,537	4,170
5.6 MGD Existing WTP	*283*	*566*	*902*	*919*	*919*	*919*
6 MGD WTP Expansion				*427*	*1,618*	*3,251*
Infrastructure to delivery to customers				*427*	*1,618*	*3,251*
Total Supplies from Strategies	**322**	**639**	**989**	**1,461**	**2,714**	**4,432**
Total Supplies	**2,542**	**2,859**	**3,209**	**3,681**	**4,934**	**6,652**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.82
Summary of Costs for West Cedar Creek Municipal Utility District Recommended Strategies

Strategy	**Date to be Developed**	**Quantity for WCCMUD (Ac-Ft/Yr)**	**WCCMUD Share of Capital Costs**	**Unit Cost ($/1000 gal)**		**Table for Details**
				With Debt Service	**After Debt Service**	
Conservation (retail)	2020	67	$54,495	$1.27	$0.00	Q-10
Conservation (wholesale customers)	2020	195	Included under County Summaries in Section 5D.			
Additional TRWD	2020	4,170	$0	$0.97	$0.97	None
6 MGD WTP Expansion	*2050*	*3,251*	$17,429,000	$1.96	$0.59	Q-13
Total WCCMUD Capital Costs			**$17,483,495**			

5C.2.28 **Wise County Water Supply District**

Wise County Water Supply District supplies water to Decatur, Wise County Manufacturing, and some rural customers outside Decatur (Wise County Other). Wise County WSD is expected to continue serving these customers in the future.

The current water supply for Wise County WSD is water purchased from the Tarrant Regional Water District (TRWD) out of Lake Bridgeport. This current supply is limited by Wise County WSD's current treatment capacity. The recommended strategies for Wise County WSD include implementing water conservation measures, purchasing additional water from TRWD (increasing contract amounts as needed in the future), and expanding water treatment capacity. Table 5C.83 shows the recommended water management strategies for the Wise County WSD. Table 5C.84 shows the costs of the strategies.

Table 5C.83
Summary of Recommended Water Management Strategies for Wise County WSD

Planned Supplies (Ac-Ft/Yr)	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Demands (Table H.37)	**3,558**	**4,321**	**5,184**	**7,898**	**10,230**	**12,553**
Currently Available Supplies						
TRWD Limited by WTP Capacity (3.3 MGD)	*1,850*	*1,850*	*1,850*	*1,850*	*1,850*	*1,850*
Current Supply	***1,850***	***1,850***	***1,850***	***1,850***	***1,850***	***1,850***
Need (Demand - Supply)	**1,708**	**2,471**	**3,334**	**6,048**	**8,380**	**10,703**
Water Management Strategies						
Conservation (Decatur)	43	80	122	175	226	286
Conservation (other customers)	8	8	7	14	18	20
Additional TRWD with Treatment plants as below:	1,657	2,383	3,205	5,859	8,136	10,397
10 MGD WTP Expansion-1	*1,657*	*2,383*	*3,205*	*5,605*	*5,605*	*5,605*
10 MGD WTP Expansion-2				*254*	*2,531*	*4,792*
Total Supplies from Strategies	**1,708**	**2,471**	**3,334**	**6,048**	**8,380**	**10,703**
Total Supplies	**3,558**	**4,321**	**5,184**	**7,898**	**10,230**	**12,553**
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Management Supply Factor	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Table 5C.84
Summary of Costs for Wise County Water Supply District Recommended Strategies

Strategy	Date to be Developed	Quantity for Wise Co. WSD (Ac-Ft/Yr)	Wise Co. WSD Share of Capital Costs	Unit Cost ($/1000 gal)		Table for Details
				With Debt Service	After Debt Service	
Conservation (Decatur)	2020	286	$238,239	$3.10	$1.00	Q-10
Conservation (other customers)	2020	20	Included under County Summaries in Section 5D.			
Add'l TRWD	2020	10,397	$0	$0.97	$0.97	None
10 MGD WTP Expansion-1	*2020*	*5,605*	$25,992,000	$1.70	$0.51	Q-13
10 MGD WTP Expansion-2	*2050*	*4,792*	$25,992,000	$1.99	$0.59	Q-13
Total Wise Co. WSD Capital Costs			**$52,222,239**			

SECTION 5C
LIST OF REFERENCES

(1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2001 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2001.

(2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2006.

(3) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CPY, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

(4) Sulphur River Basin Authority: Sulphur River Basin Feasibility Study, [Online], Available URL: http://srbatx.org/sulphur-basin-feasibility-study/, accessed January 2015.

(5) HDR Engineering, Inc.: *Draft 2014 Dallas Long Range Water Supply Plan to 2070 and Beyond*, October, 2014.

5D Recommended Water Management Strategies for Water User Groups by County

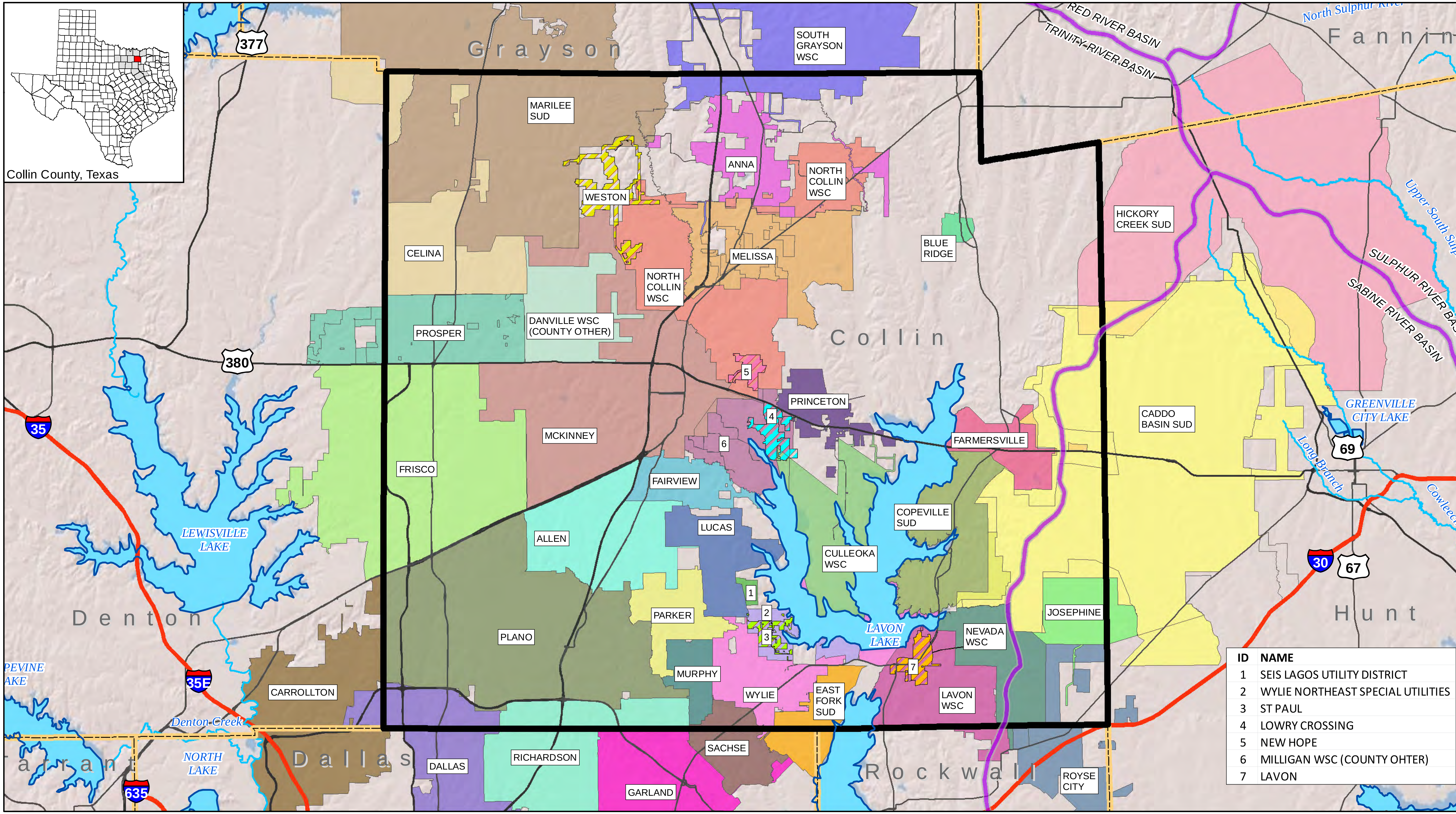
Appendix C includes a summary of the projected demands, current water supplies, and recommended water management strategies to provide additional supplies for each water user group in alphabetical order. Water management strategies and costs for wholesale water providers are discussed in Section 5C. The recommended strategies for the remaining water user groups in Region C (those that are not also wholesale water providers) are discussed by county below. For water user groups that are located in multiple counties, the discussion is in the county with the largest share of their population.

As part of the preparation of this regional water plan, consultants surveyed municipal WUGs to gather information regarding current and future water plans. As appropriate and available, information regarding non-municipal WUGs was gathered from those entities supplying water to those water demands. In addition, published plans of WUGs if available were considered in the preparation of this final adopted regional plan.

Many of the strategies included in this section are infrastructure projects needed to delivery and/or treat water included in another strategy. Quantities for these infrastructure projects have been shown in *gray italics* so they can be easily identified. To avoid double-counting quantities of supply, the quantities in *gray italics* are not included in the totals for the tables.

5D.1 Collin County

Figure 5D.1 is a map of Collin County. Collin County is in the North Texas Groundwater Conservation District. Most Collin County water user groups receive their water supplies from the North Texas Municipal Water District (NTMWD). Other sources of supply in Collin County include groundwater, Upper Trinity Regional Water District, Dallas, and local supplies. According to available data from the Texas Water Development Board, groundwater pumping from both the Trinity and Woodbine aquifers in Collin County in 2011 was very close to the limit of the modeled available groundwater supplies. NTMWD will continue to supply most of the water used in the county. Water user groups that currently get water from NTMWD will purchase additional water from NTMWD to meet future demands, and some Collin County suppliers that do not currently get water from NTMWD are expected to do so in the future. Section 5C



FREESE AND NICHOLS

Project No: NTD11336

Service Area
County Boundary
Collin County Boundary
River Basin Divide
Stream
Reservoir

N E S W

1 inch = 4 miles

0 2 4 8

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Collin County, Texas

Figure 5D.1

includes a discussion of the current and future sources of supply for NTMWD as a wholesale water provider.

The Greater Texoma Utility Authority (GTUA) is the sponsor of the Collin-Grayson Municipal Alliance Pipeline project, which supplies NTMWD water to Anna and Melissa in Collin County and to water user groups in Grayson County. Future expansions of this project will increase the capacity of the system. The cost for future expansions of the Collin-Grayson Municipal Alliance Pipeline Project is included under GTUA in Section 5C.

Water management strategies for Collin County water user groups are discussed below (in alphabetical order). The costs for Collin County water user groups are summarized in Tables 5D.37 and Table 5D.38, followed by a summary for Collin County.

It should be noted the population and demand projections for this plan were approved in August 2013. Those population projections were developed using the most current information availability at the time, specifically the 2013 Collin County Mobility Plan study. In October 2015, Collin County updated the population projections for their Mobility Plan using significantly different development assumptions. This resulted in much higher total buildout populations for the county, increasing by over 50 percent. As a result, the population and municipal demand projections used in this 2016 Region C Water Plan for Collin County may be increased significantly in future regional plans. This updated information will be included in future Region C plans with appropriate strategies to meet these higher demands.

Allen

Allen is a city of slightly over 90,000 people located in south central Collin County. The city is nearly fully developed. Allen receives its water supply from NTMWD and will continue to be supplied by NTMWD. Table 5D.1 shows the projected population and demand, the current supplies, and the water management strategies for Allen.

Table 5D.1
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Allen

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**98,500**	**98,500**	**98,500**	**98,500**	**98,500**	**98,500**
Projected Water Demand						
Municipal Demand	20,533	20,336	20,215	20,139	20,108	20,106
Manufacturing Demand (3% of Collin Co)	104	117	130	141	153	166
Total Projected Water Demand	***20,637***	***20,453***	***20,345***	***20,280***	***20,261***	***20,272***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Currently Available Water Supplies						
North Texas Municipal Water District	18,917	15,582	14,277	13,407	12,545	11,611
NTMWD for Manufacturing	96	89	92	94	96	96
Total Current Supplies	***19,013***	***15,671***	***14,369***	***13,501***	***12,641***	***11,707***
Need (Demand - Current Supply)	***1,624***	***4,782***	***5,976***	***6,779***	***7,620***	***8,565***
Water Management Strategies						
Water Conservation	763	953	1,002	1,047	1,113	1,180
Water Conservation (manufacturing)	0	0	3	4	4	5
Additional Water from NTMWD	853	3,801	4,936	5,685	6,450	7,315
Additional NTMWD for Manufacturing	8	28	35	43	53	65
Total Water Management Strategies	***1,624***	***4,782***	***5,976***	***6,779***	***7,620***	***8,565***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Anna

Anna has a population of about 10,000 and is expected to experience rapid growth in the coming decades. Anna is in north Collin County and currently receives its water supply from groundwater (Trinity and Woodbine Aquifers) and from NTMWD (through GTUA's Collin-Grayson Municipal Alliance project). Water management strategies for Anna are conservation and expansion of the supply from NTMWD through the Collin-Grayson Municipal Alliance. Table 5D.2 shows the projected population and demand, the current supplies, and the water management strategies for Anna.

Table 5D.2
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Anna

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**11,943**	**13,929**	**22,984**	**31,000**	**59,000**	**89,000**
Projected Water Demand						
Municipal Demand	1,898	2,190	3,588	4,826	9,167	13,820
Total Projected Water Demand	***1,898***	***2,190***	***3,588***	***4,826***	***9,167***	***13,820***
Currently Available Water Supplies						
Trinity Aquifer	216	216	216	216	216	216
Woodbine Aquifer	706	706	706	706	706	706

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
North Texas Municipal Water District (Collin-Grayson Municipal Alliance)	899	972	1,668	1,668	1,668	1,668
Total Current Supplies	***1,821***	***1,894***	***2,590***	***2,590***	***2,590***	***2,590***
Need (Demand - Current Supply)	***77***	***296***	***998***	***2,236***	***6,577***	***11,230***
Water Management Strategies						
Water Conservation	79	211	36	64	153	276
Expand Collin-Grayson Municipal Alliance, Additional Water from NTMWD	0	85	962	2,172	6,424	10,954
Total Water Management Strategies	***79***	***296***	***998***	***2,236***	***6,577***	***11,230***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**
Alternative Water Management Strategy						
Grayson County Water Supply Project (Sherman WTP)	0	85	962	2,172	6,424	10,954

Blue Ridge

Blue Ridge is a city of about 1,000 people in northeast Collin County. The city's current water supply is groundwater (Woodbine Aquifer). Water management strategies for Blue Ridge are conservation, establishing a direct connection to NTMWD, and purchasing water from NTMWD. Table 5D.3 shows the projected population and demand, the current supplies, and the water management strategies for Blue Ridge.

Table 5D.3
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Blue Ridge

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**925**	**2,000**	**4,000**	**12,000**	**25,000**	**39,000**
Projected Water Demand						
Municipal Demand	92	185	362	1,412	3,221	5,461
Total Projected Water Demand	***92***	***185***	***362***	***1,412***	***3,221***	***5,461***
Currently Available Water Supplies						
Woodbine Aquifer	92	92	92	92	92	92
Total Current Supplies	***92***	***92***	***92***	***92***	***92***	***92***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***0***	***93***	***270***	***1,320***	***3,129***	***5,369***
Water Management Strategies						
Water Conservation	1	2	4	19	54	109
Initial Connection & Water from NTMWD	0	109	308	1,363	2,242	2,242
Upsize Connection & Water from NTWMD	0	0	0	0	895	3,080
Total Water Management Strategies	***1***	***111***	***312***	***1,382***	***3,191***	***5,431***
Reserve (Shortage)	**1**	**18**	**42**	**62**	**62**	**62**

Caddo Basin Special Utility District

Caddo Basin SUD has a current population of about 8,800, split almost evenly between Collin County in Region C and Hunt County in Region D. The SUD is expected to experience substantial growth, growing more rapidly in Hunt County than in Collin County. Caddo Basin SUD currently receives its water supply from NTMWD and is expected to continue to use NTMWD supplies. Water management strategies for Caddo Basin SUD are conservation and additional water from NTMWD. Table 5D.4 shows the projected population and demand, the current supplies, and the water management strategies for Caddo Basin SUD.

Table 5D.4
Projected Population and Demand, Current Supplies, and Water Management Strategies for Caddo Basin Special Utility District (Regions C and D)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**8,837**	**11,401**	**15,201**	**20,067**	**26,576**	**35,581**
Projected Water Demand						
Municipal Demand	986	1,219	1,586	2,071	2,736	3,659
Total Projected Water Demand	***986***	***1,219***	***1,586***	***2,071***	***2,736***	***3,659***
Currently Available Water Supplies						
North Texas Municipal Water District	913	937	1,124	1,383	1,712	2,121
Total Current Supplies	***913***	***937***	***1,124***	***1,383***	***1,712***	***2,121***
Need (Demand - Current Supply)	***73***	***282***	***462***	***688***	***1,024***	***1,538***
Water Management Strategies						
Water Conservation	2	4	4	7	10	14
Additional Water from NTMWD	71	278	458	681	1,014	1,524
Total Water Management Strategies	***73***	***282***	***462***	***688***	***1,024***	***1,538***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Celina

The City of Celina has a population of about 6,700 people and is located in northwest Collin County. Celina is projected to grow rapidly in the coming decades and to expand into Denton County. The city currently receives its water supply from groundwater (Trinity and Woodbine Aquifers) and from Upper Trinity Regional Water District (UTRWD). Water management strategies for Celina are conservation, additional water from UTRWD, establishing a direct connection to NTMWD, and purchasing water from NTMWD. Table 5D.5 shows the projected population and demand, the current supplies, and the water management strategies for Celina.

Table 5D.5
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Celina

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**22,675**	**48,000**	**89,000**	**150,000**	**150,000**	**150,000**
Projected Water Demand						
Municipal Demand	4,716	9,889	18,303	30,828	30,826	30,823
Total Projected Water Demand	***4,716***	***9,889***	***18,303***	***30,828***	***30,826***	***30,823***
Currently Available Water Supplies						
Trinity Aquifer	132	132	132	132	132	132
Woodbine Aquifer	62	62	62	62	62	62
Upper Trinity Regional Water District	3,083	3,083	3,083	3,083	3,082	2,479
Total Current Supplies	***3,277***	***3,277***	***3,277***	***3,277***	***3,276***	***2,673***
Need (Demand - Current Supply)	***1,439***	***6,612***	***15,026***	***27,551***	***27,550***	***28,150***
Water Management Strategies						
Water Conservation	86	238	549	1,028	1,130	1,233
Additional Water from UTRWD	1,353	4,874	11,477	21,523	21,420	21,917
Connection to NTMWD and Supply	0	1,500	3,000	5,000	5,000	5,000
Total Water Management Strategies	***1,439***	***6,612***	***15,026***	***27,551***	***27,550***	***28,150***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Collin County Irrigation

Table 5D.6 shows the projected demand, the current supplies, and the water management strategies for Collin County Irrigation. Most irrigation in Collin County is for golf course irrigation. (The Texas Water Development classifies the use of potable water for golf course irrigation as a part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.) As shown in Table 5D.6, groundwater (direct and through Frisco), direct reuse, local sources, and Dallas Water Utilities all provide water for irrigation in Collin County. Conservation is the only water management strategy for Collin County Irrigation.

Table 5D.6
Projected Demand, Current Supplies, and
Water Management Strategies for Collin County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**2,995**	**2,995**	**2,995**	**2,995**	**2,995**	**2,995**
Currently Available Water Supplies						
Direct Reuse (The Colony)	457	457	457	457	457	457
Direct Reuse (NTMWD)	1,847	1,847	1,847	1,847	1,847	1,847
Trinity Aquifer (Through Frisco)	100	100	100	100	100	100
Woodbine Aquifer (Through Frisco)	40	40	40	40	40	40
Trinity Aquifer	870	870	870	870	870	870
Woodbine Aquifer	97	97	97	97	97	97
DWU Sources	1,719	1,564	1,396	1,287	1,204	1,147
Local Supplies	408	408	408	408	408	408
Total Current Supplies	***5,538***	***5,383***	***5,215***	***5,106***	***5,023***	***4,966***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	5	83	159	199	237	275
Total Water Management Strategies	***5***	***83***	***159***	***199***	***237***	***275***
Reserve (Shortage)	**2,548**	**2,471**	**2,379**	**2,310**	**2,265**	**2,246**

Collin County Livestock

Table 5D.7 shows the projected demand and the current supplies for Collin County Livestock. The current supplies for Collin County Livestock are local surface water supplies. This source is sufficient to meet future demands and there are no water management strategies for this water user group.

Table 5D.7
Projected Demand, Current Supplies, and
Water Management Strategies for Collin County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**860**	**860**	**860**	**860**	**860**	**860**
Currently Available Water Supplies						
Livestock Local Supply	1,002	1,002	1,002	1,002	1,002	1,002
Total Current Supplies	***1,002***	***1,002***	***1,002***	***1,002***	***1,002***	***1,002***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**142**	**142**	**142**	**142**	**142**	**142**

Collin County Manufacturing

Table 5D.8 shows the projected demand, the current supplies, and the water management strategies for Collin County Manufacturing. Most manufacturing in Collin County is supplied by cities that obtain their water from NTMWD, and there is some supply from the Woodbine Aquifer. Conservation, additional supplies from NTMWD, and new wells in the Woodbine Aquifer are the water management strategies to meet demands.

Table 5D.8
Projected Demand, Current Supplies, and
Water Management Strategies for Collin County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**3,456**	**3,888**	**4,319**	**4,706**	**5,109**	**5,547**
Currently Available Water Supplies						
Woodbine Aquifer	200	200	200	200	200	200
NTMWD thru Richardson (60%)	1,910	1,788	1,830	1,880	1,913	1,922
NTMWD thru Plano (12%)	382	358	366	376	383	384
NTMWD thru McKinney (15%)	478	447	458	470	478	481
NTMWD thru Allen (3%)	96	89	92	94	96	96
NTMWD thru Frisco (4%)	127	119	122	125	128	128
NTMWD thru Wylie (1%)	32	30	31	31	32	32
Total Current Supplies	***3,225***	***3,031***	***3,099***	***3,176***	***3,230***	***3,243***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***231***	***857***	***1,220***	***1,530***	***1,879***	***2,304***
Water Management Strategies						
Water Conservation	0	8	90	133	145	157
Additional Water from NTMWD	259	858	1,117	1,369	1,686	2,076
New Wells in Woodbine Aquifer	0	78	78	78	78	78
Total Water Management Strategies	***259***	***944***	***1,285***	***1,580***	***1,909***	***2,311***
Reserve (Shortage)	**28**	**87**	**65**	**50**	**30**	**7**

Collin County Mining

Table 5D.9 shows the projected demand, the current supplies, and the water management strategies for Collin County Mining. There is no demand, current supply, or water management strategy for Collin County Mining.

Table 5D.9
Projected Demand, Current Supplies, and
Water Management Strategies for Collin County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**0**	**0**	**0**	**0**	**0**	**0**
Currently Available Water Supplies						
None	0	0	0	0	0	0
Total Current Supplies	***0***	***0***	***0***	***0***	***0***	***0***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Collin County Other

Collin County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included in Collin County Other currently receive their water supply from either groundwater (Trinity and/or Woodbine aquifers) or from NTMWD (through various suppliers). Water management strategies for these entities include conservation and additional water from NTMWD. Table 5D.10 shows the projected population and demand, the current supplies, and the water management strategies for Collin County Other.

Table 5D.10
Projected Population and Demand, Current Supplies, and Water Management Strategies for Collin County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**10,289**	**10,289**	**10,289**	**35,000**	**50,000**	**80,000**
Projected Water Demand						
Municipal Demand	1,613	1,582	1,560	5,213	7,434	11,885
Total Projected Water Demand	***1,613***	***1,582***	***1,560***	***5,213***	***7,434***	***11,885***
Currently Available Water Supplies						
Trinity Aquifer	250	250	250	250	250	250
Woodbine Aquifer	247	247	247	247	247	247
North Texas Municipal Water District	1,028	831	751	3,140	4,328	6,577
Total Current Supplies	***1,525***	***1,328***	***1,248***	***3,637***	***4,825***	***7,074***
Need (Demand - Current Supply)	***88***	***254***	***312***	***1,576***	***2,609***	***4,811***
Water Management Strategies						
Water Conservation	13	19	16	70	124	238
Additional Water from NTMWD	75	235	296	1,506	2,485	4,573
Total Water Management Strategies	***88***	***254***	***312***	***1,576***	***2,609***	***4,811***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Collin County Steam Electric Power

Table 5D.11 shows the projected demand, the current supplies, and the water management strategies for Collin County Steam Electric Power. Collin County Steam Electric Power is currently supplied by raw water purchased from NTMWD. The water management strategy for this water user group is additional supplies from NTMWD. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.11
Projected Demand, Current Supplies,
Water Management Strategies for Collin County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**715**	**602**	**740**	**594**	**782**	**724**
Currently Available Water Supplies						
North Texas Municipal Water District	659	461	523	395	488	418
Total Current Supplies	***659***	***461***	***523***	***395***	***488***	***418***
Need (Demand - Current Supply)	***56***	***141***	***217***	***199***	***294***	***306***
Water Management Strategies						
Additional Water from NTMWD	56	141	217	199	294	306
Total Water Management Strategies	***56***	***141***	***217***	***199***	***294***	***306***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Copeville Special Utility District

The service area for Copeville SUD is on the east shore of Lake Lavon in eastern Collin County. The SUD supplies about 3,500 people and receives its water supply from NTMWD. Water management strategies for Copeville SUD are conservation and additional water from NTMWD. Table 5D.12 shows the projected population and demand, the current supplies, and the water management strategies for Copeville SUD.

Table 5D.12
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Copeville Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,846**	**4,804**	**5,972**	**8,000**	**14,000**	**24,000**
Projected Water Demand						
Municipal Demand	319	376	452	596	1,037	1,773
Total Projected Water Demand	***319***	***376***	***452***	***596***	***1,037***	***1,773***
Currently Available Water Supplies						
NTMWD	294	288	319	397	647	1,024
Total Current Supplies	***294***	***288***	***319***	***397***	***647***	***1,024***
Need (Demand - Current Supply)	***25***	***88***	***133***	***199***	***390***	***749***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	3	4	5	8	17	35
Additional Water from NTWMD	22	84	128	191	373	714
Total Water Management Strategies	***25***	***88***	***133***	***199***	***390***	***749***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Culleoka Water Supply Corporation

The service area for Culleoka WSC is located between the two arms of Lake Lavon in central Collin County. The WSC supplies about 4,500 people and receives its water supply from NTMWD through Princeton. Water management strategies for Culleoka WSC are conservation and additional water from NTMWD through Princeton. Table 5D.13 shows the projected population and demand, the current supplies, and the water management strategies for Culleoka WSC.

Table 5D.13
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Culleoka Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,500**	**5,500**	**9,000**	**11,000**	**12,000**	**15,000**
Projected Water Demand						
Municipal Demand	328	370	605	740	807	1,009
Total Projected Water Demand	***328***	***370***	***605***	***740***	***807***	***1,009***
Currently Available Water Supplies						
Princeton (NTMWD)	302	284	427	493	503	583
Total Current Supplies	***302***	***284***	***427***	***493***	***503***	***583***
Need (Demand - Current Supply)	***26***	***86***	***178***	***247***	***304***	***426***
Water Management Strategies						
Water Conservation	3	4	6	10	13	20
Additional Water from Princeton	23	82	172	237	291	406
Total Water Management Strategies	***26***	***86***	***178***	***247***	***304***	***426***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Dallas

Dallas Water Utilities (DWU) is the water utility of the City of Dallas, which has a population of about 1,230,000. DWU is a wholesale water provider. The City of Dallas is primarily in Dallas County but extends into Collin County and other counties. There is a detailed discussion of water supply plans for DWU in Section 5C.1.

East Fork Special Utility District

East Fork SUD is located in southern Collin County and extends into Dallas and Rockwall Counties. East Fork SUD serves portions of the WUGs Collin County Other and Rockwall County Other. The SUD receives its water supply from NTMWD. Water management strategies for East Fork SUD are conservation and additional water from NTMWD with an increase in delivery infrastructure from NTWMD. Table 5D.14 shows the projected population and demand, the current supplies, and the water management strategies for East Fork SUD.

Table 5D.14
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the East Fork Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population (including portions of Collin and Rockwall County Other)	**11,802**	**15,426**	**19,000**	**26,352**	**34,440**	**45,012**
Projected Water Demand						
Municipal Demand	572	721	891	1,081	1,293	1,520
Collin County Other Demand	382	516	625	1,016	1,441	2,048
Rockwall County Other Demand	104	145	187	264	352	466
Total Projected Demand	***1,058***	***1,382***	***1,703***	***2,361***	***3,086***	***4,034***
Currently Available Water Supplies						
NTWMD	527	552	629	720	807	878
NTWMD for Collin Co Other	352	395	441	676	899	1,183
NTWMD for Rockwall Co Other	96	111	132	176	220	269
Total Current Supplies	***975***	***1,058***	***1,202***	***1,572***	***1,926***	***2,330***
Need (Demand - Current Supply)	***83***	***324***	***501***	***789***	***1,160***	***1,704***
Water Management Strategies						
Water Conservation	5	8	9	14	22	30
Water Conservation-Collin Co Other	3	6	6	14	24	41
Water Conservation-Rockwall Co Other	1	2	2	3	6	9
Additional Water from NTMWD	40	161	253	347	464	612
Add'l NTMWD for Collin Co Other	27	115	178	326	518	824

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Add'l NTMWD for Rockwall Co Other	7	32	53	85	126	188
Increase delivery infrastructure from NTWMD	*74*	*308*	*483*	*758*	*1,108*	*1,624*
Total Water Management Strategies	***83***	***324***	***501***	***789***	***1,160***	***1,704***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fairview

The City of Fairview is located in central Collin County and has a population of about 8,300. The city receives its water supply from NTMWD. Water management strategies for Fairview are conservation and additional water from NTMWD. Table 5D.15 shows the projected population and demand, the current supplies, and the water management strategies for Fairview.

Table 5D.15
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Fairview

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**13,000**	**15,000**	**20,025**	**20,025**	**20,025**	**20,025**
Projected Water Demand						
Municipal Demand	4,644	5,329	7,094	7,087	7,084	7,083
Total Projected Demand	***4,644***	***5,329***	***7,094***	***7,087***	***7,084***	***7,083***
Currently Available Water Supplies						
North Texas Municipal Water District	4,279	4,083	5,010	4,718	4,420	4,091
Total Current Supplies	***4,279***	***4,083***	***5,010***	***4,718***	***4,420***	***4,091***
Need (Demand - Current Supply)	***365***	***1,246***	***2,084***	***2,369***	***2,664***	***2,992***
Water Management Strategies						
Water Conservation	91	145	219	243	266	290
Additional Water from NTMWD	274	1,101	1,865	2,126	2,398	2,702
Total Water Management Strategies	***365***	***1,246***	***2,084***	***2,369***	***2,664***	***2,992***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Farmersville

The City of Farmersville is located in western Collin County and receives its water supply from NTMWD. The city has a current population of about 3,300, and it is expected to grow rapidly in the coming decades. Water management strategies for Farmersville are conservation and additional water from NTMWD.

Table 5D.16 shows the projected population and demand, the current supplies, and the water management strategies for Farmersville.

Table 5D.16
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Farmersville

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**8,000**	**20,000**	**20,000**	**20,000**	**20,000**	**20,000**
Projected Water Demand						
Municipal Demand	958	2,310	2,299	2,293	2,291	2,291
Total Projected Demand	***958***	***2,310***	***2,299***	***2,293***	***2,291***	***2,291***
Currently Available Water Supplies						
North Texas Municipal Water District	883	1,770	1,624	1,526	1,429	1,323
Total Current Supplies	***883***	***1,770***	***1,624***	***1,526***	***1,429***	***1,323***
Need (Demand - Current Supply)	***75***	***540***	***675***	***767***	***862***	***968***
Water Management Strategies						
Water Conservation	8	20	23	31	38	46
Additional Water from NTMWD	67	520	652	736	824	922
Total Water Management Strategies	***75***	***540***	***675***	***767***	***862***	***968***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Frisco

The City of Frisco is a rapidly growing community in west Collin County and east Denton County. The city has a population of about 140,000 and is expected to continue to grow rapidly. Since the time the population projections were approved for this regional plan (July 2013), more recent data indicates that the buildout population of Frisco may be closer to 350,000 rather than the 280,000 shown in this report. It is likely that this population is included in this plan in the overall population of Collin County, simply in another water user group. Adjustments for this population shift will be made in the next update of the regional plan. Frisco receives its potable water supply from NTMWD. Frisco also received its water from the Trinity aquifer and Woodbine aquifer for irrigation. Water management strategies for Frisco are conservation, additional water from NTMWD, and development of a direct reuse project for irrigation of parks and schools. Table 5D.17 shows the projected population and demand, the current supplies, and the water management strategies for Frisco.

Table 5D.17
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Frisco

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**171,326**	**225,663**	**280,000**	**280,000**	**280,000**	**280,000**
Projected Water Demand						
Municipal Demand	41,595	54,375	67,287	67,224	67,180	67,167
Manufacturing (4% of Collin Co)	138	156	173	188	204	222
Collin County Irrigation	140	140	140	140	140	140
Total Projected Demand	***41,873***	***54,671***	***67,600***	***67,552***	***67,524***	***67,529***
Currently Available Water Supplies						
North Texas Municipal Water District	36,258	39,090	43,532	40,991	38,388	35,527
NTWMD (for manufacturing)	127	119	122	125	128	128
Trinity Aquifer (for Irrigation)	100	100	100	100	100	100
Woodbine Aquifer (for Irrigation)	40	40	40	40	40	40
Total Current Supplies	***36,525***	***39,349***	***43,794***	***41,256***	***38,656***	***35,795***
Need (Demand - Current Supply)	***5,348***	***15,322***	***23,806***	***26,296***	***28,868***	***31,734***
Water Management Strategies						
Water Conservation	1,730	2,645	3,572	3,793	4,015	4,238
Water Conservation - Manufacturing	0	0	4	5	6	6
Add'l Water from NTMWD for Frisco	1,367	9,280	14,533	16,790	19,127	21,752
Add'l Water from NTMWD for Manufacturing	11	37	47	58	70	88
Direct Reuse	2,240	3,360	5,650	5,650	5,650	5,650
Total Water Management Strategies	***5,348***	***15,322***	***23,806***	***26,296***	***28,868***	***31,734***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Hickory Creek Special Utility District

Hickory Creek SUD is primarily located in Hunt County in the North East Texas Region (Region D), with some service area in northeast Collin County and south Fannin County in Region C. Water management strategies for Region C are described under Fannin County in Section 5D.6.

Josephine

Josephine is located in southeastern Collin County, with a small part of the city in Hunt County in the North East Texas Region (Region D). Josephine has a population of about 1,000 and receives its water supply from NTMWD. Water management strategies for Josephine are conservation and additional water from

NTMWD. Table 5D.18 shows the projected population and demand, the current supplies, and the water management strategies for Josephine.

Table 5D.18
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Josephine (Region C and D)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,859**	**2,906**	**3,953**	**5,000**	**5,000**	**5,000**
Projected Water Demand						
Municipal Demand	278	424	573	722	722	722
Total Projected Demand	***278***	***424***	***573***	***722***	***722***	***722***
Currently Available Water Supplies						
North Texas Municipal Water District	238	299	367	427	400	370
Total Current Supplies	***238***	***299***	***367***	***427***	***400***	***370***
Need (Demand - Current Supply)	***40***	***125***	***206***	***295***	***322***	***352***
Water Management Strategies						
Water Conservation	2	4	5	9	11	13
Additional Water from NTMWD	38	121	201	286	311	339
Total Water Management Strategies	***40***	***125***	***206***	***295***	***322***	***352***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Lavon

Lavon has a population of about 3,500 in Collin County. The city of Lavon is supplied water by Lavon Special Utility District which receives its water supply from NTMWD. Water management strategies for Lavon are conservation and additional water from Lavon SUD. Table 5D.19 shows the projected population and demand, the current supplies, and the water management strategies for Lavon.

Table 5D.19
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Lavon

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,500**	**4,500**	**6,885**	**8,891**	**20,000**	**45,000**
Projected Water Demand						
Municipal Demand	559	711	1,081	1,392	3,125	7,025
Total Projected Demand	***559***	***711***	***1,081***	***1,392***	***3,125***	***7,025***

(Values in Ac-Ft/Yr) **Currently Available Water Supplies**	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
North Texas Municipal Water District (Through Lavon SUD)	515	545	763	927	1,950	4,057
Total Current Supplies	***515***	***545***	***763***	***927***	***1,950***	***4,057***
Need (Demand - Current Supply)	***44***	***166***	***318***	***465***	***1,175***	***2,968***
Water Management Strategies						
Water Conservation	10	18	32	19	52	141
Additional Water from NTMWD	34	148	286	446	1,123	2,827
Total Water Management Strategies	***44***	***166***	***318***	***465***	***1,175***	***2,968***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Lavon Special Utility District

Lavon SUD has a population of about 5,200, split between Collin and Rockwall Counties in Region C. In addition to its own service area, Lavon SUD supplies water to the city of Lavon. The SUD receives its water supply from NTMWD and is projected to grow rapidly in the coming decades. Water management strategies for Lavon SUD are conservation and additional water from NTMWD. Table 5D.20 shows the projected population and demand, the current supplies, and the water management strategies for Lavon SUD.

Table 5D.20
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Lavon Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**5,000**	**6,200**	**7,819**	**10,303**	**18,000**	**35,000**
Projected Water Demand						
Municipal Demand	590	711	881	1,152	2,007	3,897
Lavon	559	711	1,081	1,392	3,125	7,025
Total Projected Demand	***1,149***	***1,422***	***1,962***	***2,544***	***5,132***	***10,922***
Currently Available Water Supplies						
North Texas Municipal Water District	544	545	622	767	1,252	2,251
NTMWD for Lavon	515	545	763	927	1,950	4,057
Total Current Supplies	***1,059***	***1,090***	***1,386***	***1,694***	***3,202***	***6,308***
Need (Demand - Current Supply)	***90***	***332***	***576***	***850***	***1,930***	***4,614***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation Lavon SUD	5	8	9	15	33	78
Water Conservation Lavon	10	18	32	19	52	141
Add'l Water from NTMWD Lavon SUD	41	158	250	370	722	1,568
Add'l Water from NTMWD Lavon	34	148	286	446	1,123	2,827
Total Water Management Strategies	***90***	***332***	***576***	***850***	***1,930***	***4,614***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Lowry Crossing

The City of Lowry Crossing has a population of about 1,900 and is located in central Collin County. Lowry Crossing receives its water supply from NTMWD through Milligan WSC. (Milligan WSC is no longer considered by TWDB to be a water user group for regional planning and is now part of Collin County Other). Water management strategies for Lowry Crossing are conservation and additional water from NTMWD through Milligan WSC. Table 5D.21 shows the projected population and demand, the current supplies, and the water management strategies for Lowry Crossing.

Table 5D.21
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Lowry Crossing

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,040**	**2,446**	**3,000**	**3,000**	**3,000**	**3,000**
Projected Water Demand						
Municipal Demand	222	257	308	306	305	305
Total Projected Demand	***222***	***257***	***308***	***306***	***305***	***305***
Currently Available Water Supplies						
Milligan WSC (NTMWD)	205	197	218	204	190	176
Total Current Supplies	***205***	***197***	***218***	***204***	***190***	***176***
Need (Demand - Current Supply)	***17***	***60***	***90***	***102***	***115***	***129***
Water Management Strategies						
Water Conservation	2	3	3	4	5	6
Additional Water from Milligan WSC	15	57	87	98	110	123
Total Water Management Strategies	***17***	***60***	***90***	***102***	***115***	***129***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Lucas

The City of Lucas has a population of about 6,000 and is located in south central Collin County. Lucas receives its water supply from NTMWD. Water management strategies for Lucas are conservation and additional water from NTMWD. Table 5D.22 shows the projected population and demand, the current supplies, and the water management strategies for Lucas.

Table 5D.22
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Lucas

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**7,200**	**8,200**	**10,857**	**12,131**	**13,406**	**13,406**
Projected Water Demand						
Municipal Demand	2,132	2,406	3,165	3,528	3,896	3,896
Total Projected Demand	***2,132***	***2,406***	***3,165***	***3,528***	***3,896***	***3,896***
Currently Available Water Supplies						
North Texas Municipal Water District	1,964	1,844	2,235	2,349	2,431	2,250
Total Current Supplies	***1,964***	***1,844***	***2,235***	***2,349***	***2,431***	***2,250***
Need (Demand - Current Supply)	***168***	***562***	***930***	***1,179***	***1,465***	***1,646***
Water Management Strategies						
Water Conservation	82	204	281	325	373	386
Additional Water from NTMWD	86	358	649	854	1,092	1,260
Total Water Management Strategies	***168***	***562***	***930***	***1,179***	***1,465***	***1,646***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Marilee Special Utility District (Formerly called Gunter Rural WSC)

Marilee SUD serves about 4,500 people and is located in northeastern Collin County and southeastern Grayson County. The water supply plans for Marilee SUD are discussed under Grayson County in Section 5D.8.

McKinney

The City of McKinney is the county seat of Collin County. It has a population of about 147,000 and is located in central Collin County. McKinney supplies several customers including portions of Collin County manufacturing, North Collin WSC, and Melissa. McKinney gets all of its water supply from NTMWD and will continue to do so in the future. Water management strategies for McKinney include conservation and additional water from NTMWD. Table 5D.23 shows the projected population and demand, the current supplies, and the water management strategies for McKinney.

Table 5D.23
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of McKinney

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**156,924**	**188,628**	**274,566**	**358,000**	**358,000**	**358,000**
Projected Water Demand						
Municipal Demand	34,365	40,877	59,112	76,866	76,818	76,814
Customer Demand*	717	735	758	784	817	854
Manufacturing Demand (15% of Collin Co)	518	583	648	706	766	832
Total Projected Demand	***35,600***	***42,195***	***60,518***	***78,356***	***78,401***	***78,500***
Currently Available Water Supplies						
North Texas Municipal Water District	31,661	31,322	41,748	51,171	47,927	44,361
NTMWD (for Customers)	661	563	535	522	510	493
NTMWD (for Manufacturing)	478	447	458	470	478	481
Total Current Supplies	***32,800***	***32,332***	***42,742***	***52,164***	***48,915***	***45,335***
Need (Demand - Current Supply)	***2,801***	***9,864***	***17,776***	***26,192***	***29,487***	***33,165***
Water Management Strategies						
Water Conservation	755	1,470	2,364	3,327	3,581	3,837
Water Conservation (customers)	18	23	26	29	32	35
Water Conservation (Manufacturing)	0	1	14	20	22	24
Add'l Water from NTMWD	1,949	8,085	15,000	22,368	25,310	28,616
Add'l Water from NTMWD for customers	38	149	197	233	275	326
Add'l Water from NTMWD for Manf	40	135	176	216	266	327
Total Water Management Strategies	***2,801***	***9,864***	***17,776***	***26,192***	***29,487***	***33,165***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

* Customer demand includes: 20% of North Collin WSC, and 561 ac-ft/yr for Melissa.

Melissa

Melissa is a city of about 6,200 people located in northern Collin County. The city receives its water supply from groundwater (Woodbine aquifer) and from NTMWD (through McKinney and through the GTUA Collin-Grayson Municipal Alliance pipeline) and is expected to grow rapidly in coming decades. Water management strategies for Melissa are conservation, additional water from NTMWD (through McKinney), and additional water from NTMWD (through the GTUA Collin-Grayson Municipal Alliance pipeline), and treated water supply line from NTMWD. Table 5D.24 shows the projected population and demand, the current supplies, and the water management strategies for Melissa.

Table 5D.24
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Melissa

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,978**	**9,790**	**13,216**	**30,000**	**50,000**	**75,000**
Projected Water Demand						
Municipal Demand	1,535	2,133	2,869	6,493	10,814	16,216
Total Projected Demand	***1,535***	***2,133***	***2,869***	***6,493***	***10,814***	***16,216***
Currently Available Water Supplies						
Woodbine Aquifer	201	201	201	201	201	201
North Texas Municipal Water District (through McKinney)	517	430	396	373	350	324
North Texas Municipal Water District (GTUA Collin-Grayson Municipal Alliance Pipeline)	712	1,051	1,488	3,815	6,271	8,925
Total Current Supplies	***1,430***	***1,681***	***2,085***	***4,390***	***6,822***	***9,450***
Need (Demand - Current Supply)	***105***	***452***	***784***	***2,103***	***3,992***	***6,766***
Water Management Strategies						
Water Conservation	47	81	122	298	532	852
Additional Water from NTMWD (thru McKinney)	44	131	165	188	211	237
Additional Water from NTMWD (GTUA CGMA Pipeline)	14	239	497	1,618	3,249	5,677
Total Water Management Strategies	***105***	***452***	***784***	***2,103***	***3,992***	***6,766***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Murphy

The City of Murphy is located in southern Collin County and has a population of about 19,000. The city receives its water supply from NTMWD. Water management strategies for Murphy are conservation and additional water from NTMWD. Table 5D.25 shows the projected population and demand, the current supplies, and the water management strategies for Murphy.

Table 5D.25
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Murphy

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**23,000**	**23,000**	**23,000**	**23,000**	**23,000**	**23,000**
Projected Water Demand						
Municipal Demand	5,285	5,253	5,238	5,228	5,222	5,220
Total Projected Demand	***5,285***	***5,253***	***5,238***	***5,228***	***5,222***	***5,220***
Currently Available Water Supplies						
North Texas Municipal Water District	4,869	4,025	3,699	3,480	3,258	3,015
Total Current Supplies	***4,869***	***4,025***	***3,699***	***3,480***	***3,258***	***3,015***
Need (Demand - Current Supply)	***416***	***1,228***	***1,539***	***1,748***	***1,964***	***2,205***
Water Management Strategies						
Water Conservation	124	194	210	227	245	262
Additional Water from NTMWD	291	1,034	1,329	1,521	1,719	1,943
Total Water Management Strategies	***415***	***1,228***	***1,539***	***1,748***	***1,964***	***2,205***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Nevada

The City of Nevada is located in southeast Collin County and has a population of about 700. The city receives its water supply from NTMWD (through Nevada WSC, which provides retail service in the city). Water management strategies for Nevada are conservation and additional water from NTMWD (through Nevada WSC). Table 5D.26 shows the projected population and demand, the current supplies, and the water management strategies for Nevada.

Table 5D.26
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Nevada

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**999**	**1,217**	**1,483**	**6,000**	**15,000**	**27,000**
Projected Water Demand						
Municipal Demand	96	112	133	528	1,316	2,368
Total Projected Demand	***96***	***112***	***133***	***528***	***1,316***	***2,368***
Currently Available Water Supplies						
Nevada WSC (NTMWD)	88	86	94	352	821	1,368

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***88***	***86***	***94***	***352***	***821***	***1,368***
Need (Demand - Current Supply)	***8***	***26***	***39***	***176***	***495***	***1,000***
Water Management Strategies						
Water Conservation	1	1	1	7	22	47
Additional Water from Nevada WSC	7	25	38	169	473	953
Total Water Management Strategies	***8***	***26***	***39***	***176***	***495***	***1,000***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

New Hope

The City of New Hope is located in central Collin County and has a population of about 800. New Hope receives its water supply from NTMWD through North Collin WSC. Water management strategies for New Hope are conservation and additional water from NTMWD through North Collin WSC, which provides retail service in the city. Table 5D.27 shows the projected population and demand, the current supplies, and the water management strategies for New Hope.

Table 5D.27
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of New Hope

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**770**	**962**	**1,195**	**1,445**	**1,741**	**2,077**
Projected Water Demand						
Municipal Demand	119	143	174	209	251	299
Total Projected Demand	***119***	***143***	***174***	***209***	***251***	***299***
Currently Available Water Supplies						
North Texas MWD (thru N. Collin WSC)	110	110	123	139	157	173
Total Current Supplies	***110***	***110***	***123***	***139***	***157***	***173***
Need (Demand - Current Supply)	***9***	***33***	***51***	***70***	***94***	***126***
Water Management Strategies						
Water Conservation	1	2	2	3	4	6
Additional Water from NTMWD	8	31	49	67	90	120
Total Water Management Strategies	***9***	***33***	***51***	***70***	***94***	***126***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

North Collin Water Supply Corporation

North Collin WSC is located in north Collin County and provides retail service to customers in the City of New Hope and outside of New Hope. North Collin WSC currently receives its water supply from NTMWD with a portion of the water delivered through McKinney. Water management strategies for North Collin WSC are conservation and additional water from NTMWD. Table 5D.28 shows the projected population and demand, the current supplies, and the water management strategies for North Collin WSC.

Table 5D.28
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the North Collin Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**5,319**	**6,086**	**7,020**	**8,019**	**9,202**	**10,544**
Projected Water Demand						
Municipal Demand	782	871	987	1,117	1,279	1,464
Customer Demand (New Hope)	119	143	174	209	251	299
Total Projected Demand	***901***	***1,014***	***1,161***	***1,326***	***1,530***	***1,763***
Currently Available Water Supplies						
North Texas MWD (part thru McKinney)	720	667	697	744	798	845
North Texas MWD (for New Hope)	110	110	123	139	157	173
Total Current Supplies	***830***	***777***	***820***	***883***	***955***	***1,018***
Need (Demand - Current Supply)	***71***	***237***	***341***	***443***	***575***	***745***
Water Management Strategies						
Water Conservation	7	10	10	15	21	29
Water Conservation (New Hope)	1	2	2	3	4	6
Add'l Water from NTMWD	55	194	280	358	460	590
Add'l Water from NTMWD for New Hope	8	31	49	67	90	120
Total Water Management Strategies	***71***	***237***	***341***	***443***	***575***	***745***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Parker

The City of Parker is located in south Collin County and has a population of about 4,000. The city receives its water supply from NTMWD. Water management strategies for Parker are conservation and additional water from NTMWD, including an increase in delivery infrastructure. Table 5D.29 shows the projected population and demand, the current supplies, and the water management strategies for Parker.

Table 5D.29
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Parker

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,000**	**16,000**	**20,000**	**20,000**	**20,000**	**20,000**
Projected Water Demand						
Municipal Demand	2,561	6,772	8,454	8,450	8,449	8,449
Total Projected Demand	***2,561***	***6,772***	***8,454***	***8,450***	***8,449***	***8,449***
Currently Available Water Supplies						
North Texas Municipal Water District	2,359	2,803	2,803	2,803	2,803	2,803
Total Current Supplies	***2,359***	***2,803***	***2,803***	***2,803***	***2,803***	***2,803***
Need (Demand - Current Supply)	***202***	***3,970***	***5,652***	***5,648***	***5,647***	***5,647***
Water Management Strategies						
Water Conservation	47	160	254	282	310	338
Additional Water from NTMWD	155	3,810	5,398	5,366	5,337	5,309
Increase delivery infrastructure from NTWMD		*3,810*	*5,398*	*5,366*	*5,337*	*5,309*
Total Water Management Strategies	***202***	***3,970***	***5,652***	***5,648***	***5,647***	***5,647***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Plano

Plano is a city of about 270,000 located in southwest Collin County and southeast Denton County. Plano provides water to a portion of The Colony and to some manufacturing within the city. The city receives all of its water supply from NTMWD. Water management strategies for Plano are conservation and additional water from NTMWD. Table 5D.30 shows the projected population and demand, the current supplies, and the water management strategies for Plano.

Table 5D.30
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Plano

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**268,000**	**278,000**	**290,656**	**292,656**	**292,656**	**292,656**
Projected Water Demand						
Municipal Demand	69,020	70,608	73,054	73,153	73,059	73,059
Customer Demand (The Colony)	1,200	2,000	2,200	2,400	2,600	2,800

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Manufacturing Demand (12% of Collin Co)	415	467	518	565	613	666
Total Projected Demand	***70,635***	***73,075***	***75,772***	***76,118***	***76,272***	***76,525***
Currently Available Water Supplies						
North Texas Municipal Water District	63,589	54,103	51,595	48,700	45,581	42,193
NTMWD (for The Colony)	1,106	1,532	1,554	1,598	1,622	1,617
NTMWD (for Manufacturing)	382	358	366	376	383	384
Total Current Supplies	***65,076***	***55,993***	***53,515***	***50,673***	***47,586***	***44,194***
Need (Demand - Current Supply)	***5,559***	***17,082***	***22,257***	***25,445***	***28,686***	***32,331***
Water Management Strategies						
Water Conservation	1,460	2,135	2,640	2,458	2,698	2,942
Water Conservation (The Colony)	12	26	26	37	50	65
Water Conservation (Manufacturing)	0	1	11	16	17	19
Additional Water from NTMWD	3,971	14,370	18,819	21,995	24,780	27,924
Add'l Water from NTMWD for The Colony	82	442	620	765	928	1,118
Add'l Water from NTMWD for Manufacturing	33	108	141	173	213	263
Total Water Management Strategies	***5,559***	***17,082***	***22,257***	***25,445***	***28,686***	***32,331***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Princeton

The City of Princeton is located in central Collin County and has a population of about 6,000. Princeton is a wholesale water provider, and there is a detailed discussion of water supply plans for Princeton in Section 5C.2.

Prosper

The City of Prosper is located in western Collin County and eastern Denton County and has a population of about 8,000. The city currently receives its water supply from NTMWD. Water management strategies for Prosper are conservation and additional water from NTMWD, including in increase in delivery infrastructure. Table 5D.31 shows the projected population and demand, the current supplies, and the water management strategies for Prosper.

Table 5D.31
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Prosper

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**20,754**	**32,816**	**44,878**	**56,940**	**69,000**	**69,000**
Projected Water Demand						
Municipal Demand	5,322	8,355	11,405	14,457	17,511	17,509
Total Projected Demand	***5,322***	***8,355***	***11,405***	***14,457***	***17,511***	***17,509***
Currently Available Water Supplies						
North Texas Municipal Water District	4,903	5,605	5,605	5,605	5,605	5,605
Total Current Supplies	***4,903***	***5,605***	***5,605***	***5,605***	***5,605***	***5,605***
Need (Demand - Current Supply)	***419***	***2,750***	***5,800***	***8,852***	***11,906***	***11,904***
Water Management Strategies						
Water Conservation	198	365	557	754	972	1,030
Additional Water from NTMWD	221	2,385	5,243	8,098	10,934	10,874
Increase delivery infrastructure from NTWMD	*0*	*2,385*	*5,243*	*8,098*	*10,934*	*10,874*
Total Water Management Strategies	***419***	***2,750***	***5,800***	***8,852***	***11,906***	***11,904***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Richardson

Richardson is a city of about 103,000 people located in north Dallas County and southwest Collin County. Since most of the population is in Dallas County, its water supply plans are discussed under Dallas County in Section 5D.3.

Royse City

Royse City is a city of about 10,000 people located in northeast Rockwall County and southeast Collin County. Since most of the population is in Rockwall County, its water supply plans are discussed under Rockwall County in Section 5D.14.

Sachse

Sachse is a city of about 21,500 people located in north Dallas County and south Collin County. Since most of the population is in Dallas County, its water supply plans are discussed under Dallas County in Section 5D.3.

Saint Paul

The City of Saint Paul is located in south Collin County and has a population of about 1,000. The city is provided retail water service by Wylie Northeast SUD, which gets its supply from NTMWD. Water management strategies for Saint Paul are conservation and additional water from NTMWD (through Wylie Northeast SUD). Table 5D.32 shows the projected population and demand, the current supplies, and the water management strategies for Saint Paul.

Table 5D.32
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Saint Paul

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**1,965**	**2,255**	**2,453**	**2,559**	**2,666**	**2,666**
Projected Water Demand						
Municipal Demand	265	298	322	334	348	347
Total Projected Demand	***265***	***298***	***322***	***334***	***348***	***347***
Currently Available Water Supplies						
NTMWD (through Wylie Northeast SUD)	244	228	227	222	217	200
Total Current Supplies	***244***	***228***	***227***	***222***	***217***	***200***
Need (Demand - Current Supply)	***21***	***70***	***95***	***112***	***131***	***147***
Water Management Strategies						
Water Conservation	2	3	3	4	6	7
Additional NTMWD (Wylie NE SUD)	19	67	92	108	125	140
Total Water Management Strategies	***21***	***70***	***95***	***112***	***131***	***147***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Seis Lagos Utility District

Seis Lagos Utility District is located in central Collin County on the western shore of Lake Lavon and serves a population of about 1,200. The District currently receives its water supply from NTMWD. Water management strategies for Seis Lagos UD are conservation and additional water from NTMWD. Table 5D.33 shows the projected population and demand, the current supplies, and the water management strategies for Seis Lagos UD.

Table 5D.33
Projected Population and Demand, Current Supplies, and Water Management Strategies for Seis Lagos Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**2,130**	**2,130**	**2,130**	**2,130**	**2,130**	**2,130**
Projected Water Demand						
Municipal Demand	603	598	596	594	594	594
Total Projected Demand	***603***	***598***	***596***	***594***	***594***	***594***
Currently Available Water Supplies						
North Texas Municipal Water District	556	458	421	395	371	343
Total Current Supplies	***556***	***458***	***421***	***395***	***371***	***343***
Need (Demand - Current Supply)	***47***	***140***	***175***	***199***	***223***	***251***
Water Management Strategies						
Water Conservation	34	39	41	42	44	46
Additional Water from NTMWD	13	101	134	157	179	205
Total Water Management Strategies	***47***	***140***	***175***	***199***	***223***	***251***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

South Grayson Water Supply Corporation

South Grayson Water Supply Corporation is located in south Grayson County and north Collin County and has an estimated service area population of 4,000. The water supply plans for South Grayson WSC are discussed under Grayson County in Section 5D.8.

Weston

Weston is a city of about 2,000 people located in northwest Collin County and is anticipated to experience substantial growth over the planning period. Weston gets its current water supply from groundwater (Woodbine aquifer) through Weston Water Supply Corporation. Water management strategies for Weston are conservation, new wells in the Woodbine aquifer, establishing a connection to NTMWD, and purchasing water from NTMWD all through Weston WSC. Table 5D.34 shows the projected population and demand, the current supplies, and the water management strategies for Weston.

Table 5D.34
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Weston

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,370**	**7,159**	**32,647**	**79,837**	**127,026**	**127,026**
Projected Water Demand						
Municipal Demand	506	1,060	4,814	11,768	18,723	18,721
Total Projected Demand	***506***	***1,060***	***4,814***	***11,768***	***18,723***	***18,721***
Currently Available Water Supplies						
Woodbine Aquifer	435	435	435	435	435	435
Total Current Supplies	***435***	***435***	***435***	***435***	***435***	***435***
Need (Demand - Current Supply)	***71***	***625***	***4,379***	***11,333***	***18,288***	***18,286***
Water Management Strategies						
Water Conservation	4	10	48	157	312	374
New Wells in Woodbine Aquifer	71	71	71	71	71	71
Connect to NTWMD	0	829	4,600	11,501	18,301	18,237
Total Water Management Strategies	***75***	***910***	***4,719***	***11,729***	***18,684***	***18,682***
Reserve (Shortage)	**4**	**285**	**340**	**396**	**396**	**396**

Wylie

Wylie has a population of about 44,000 and is located in southern Collin County, with some area in Dallas and Rockwall Counties. The City of Wylie currently receives its water supply from NTMWD. Water management strategies for Wylie are conservation and additional water from NTMWD. Table 5D.35 shows the projected population and demand, the current supplies, and the water management strategies for Wylie.

Table 5D.35
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Wylie

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**48,484**	**54,198**	**58,000**	**61,000**	**63,000**	**65,000**
Projected Water Demand						
Municipal Demand	7,308	8,052	8,552	8,954	9,230	9,519
Manufacturing Demand (1% of Collin Co)	35	39	43	47	51	55
Total Projected Demand	***7,343***	***8,091***	***8,595***	***9,001***	***9,281***	***9,574***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Currently Available Water Supplies						
NTWMD	6,733	6,170	6,041	5,961	5,758	5,498
NTMWD (for Manufacturing)	32	30	31	31	32	32
Total Current Supplies	***6,765***	***6,200***	***6,072***	***5,992***	***5,790***	***5,530***
Need (Demand - Current Supply)	***578***	***1,891***	***2,523***	***3,009***	***3,491***	***4,044***
Water Management Strategies						
Water Conservation	61	90	86	119	154	190
Water Conservation - manufacturing	0	0	1	1	1	2
Additional Water from NTMWD	514	1,792	2,425	2,874	3,318	3,831
Add'l Water from NTMWD for Manf	3	9	11	15	18	21
Total Water Management Strategies	***578***	***1,891***	***2,523***	***3,009***	***3,491***	***4,044***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wylie Northeast Special Utility District

Wylie Northeast SUD serves a population of about 5,500 in Collin County which includes the city of Saint Paul and portions of Collin County Other. Wylie NE SUD currently receives its water supply from NTMWD. Water management strategies for Wylie NE SUD are conservation and additional water from NTMWD. Table 5D.36 shows the projected population and demand, the current supplies, and the water management strategies for Wylie.

Table 5D.36
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Wylie Northeast Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (including Saint Paul and Collin County Other)	**5,667**	**8,667**	**10,167**	**10,917**	**12,666**	**18,666**
Projected Water Demand						
Municipal Demand	257	319	396	785	1,305	2,086
St. Paul	265	298	322	334	348	347
Collin County Other	0	111	136	0	0	0
Total Projected Demand	***522***	***728***	***854***	***1,119***	***1,653***	***2,433***
Currently Available Water Supplies						
NTWMD	237	244	280	523	814	1,205
NTWMD for St. Paul	244	228	227	222	217	200
NTWMD for Collin County Other	0	85	96	0	0	0

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***481***	***558***	***603***	***745***	***1,031***	***1,405***
Need (Demand - Current Supply)	***41***	***170***	***251***	***374***	***622***	***1,028***
Water Management Strategies						
Water Conservation	2	3	4	10	22	42
Water Conservation (St. Paul)	2	3	3	4	6	7
Water Conservation (Collin Co Other)	0	1	1	0	0	0
Additional Water from NTMWD	18	72	112	252	469	839
Additional Water from NTMWD for St. Paul	19	67	92	108	125	140
Additional Water from NTMWD for Collin County Other	0	25	39	0	0	0
Increase delivery infrastructure from NTWMD	*37*	*163*	*243*	*360*	*594*	*979*
Total Water Management Strategies	***41***	***170***	***251***	***374***	***622***	***1,028***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Costs for Collin County Water User Groups

Table 5D.37 shows the estimated capital costs for Collin County water management strategies not covered under the wholesale water providers, and Table 5D.38 summarizes the costs by category. Table 5D.38 is followed by a summary for Collin County.

Table 5D.37
Costs for Recommended Water Management Strategies for Collin County
Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Allen	Conservation	2020	1,180	$1,192,200	$1.28	$0.53	Q-10
	Additional NTMWD supplies	2020	7,315	$0	$1.70	$1.70	None
Anna	Conservation	2020	276	$71,750	$3.60	$0.00	Q-10
	Additional NTMWD supplies (CGMA)	2030	10,954	See GTUA in Section 5C.1.			

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Blue Ridge	Conservation	2020	109	$1,541	$0.40	$0.00	Q-10
	NTMWD supplies	2020	5,322	$0	$1.75	$1.75	None
	Connection to NTMWD	*2020*	*2,242*	*$2,403,656*	$2.08	$1.81	Q-69
	Upsize connection to NTMWD	*2020*	*3,080*	*$1,036,000*	$1.85	$1.76	Q-70
Caddo Basin SUD*	Conservation	2020	14	$5,212	$0.67	$0.00	Q-10
	Additional NTMWD supplies	2020	1,524	$0	$1.75	$1.75	None
Carrollton*	Conservation	See Denton County.					
	Additional DWU supplies	See Denton County.					
Celina*	Conservation	2020	1,233	$800,520	$4.43	$0.50	Q-10
	Additional UTRWD supplies	2020	21,917	$0	$3.00	$3.00	None
	Connect to NTWMD	2020	5,000	$16,314,000	$1.06	$0.22	Q-71
Collin County-Other	Conservation	2020	238	$38,848	$0.77	$0.00	Q-10
	Additional NTMWD supplies	2020	4,573	$0	$1.75	$1.75	None
Copeville SUD	Conservation	2020	35	$16,214	$1.39	$0.00	Q-10
	Additional NTMWD supplies	2020	714	$0	$1.75	$1.75	None
Culleoka WSC	Conservation	2020	20	$15,924	$1.36	$0.00	Q-10
	Additional NTMWD supplies (through Princeton)	2020	406	$0	$1.75	$1.75	None
Dallas*	Conservation	See Dallas County.					
	Other measures	See DWU in Section 5C.1.					
East Fork SUD*	Conservation	2020	30	$450,000	$23.11	$0.00	Q-10
	Additional NTMWD supplies	2020	612	$0	$1.75	$1.75	None
	Increase delivery infrastructure from NTWMD	*2020*	*1,624*	$3,500,000	$2.44	$1.89	Q-181
Fairview	Conservation	2020	290	$221,824	$1.86	$0.56	Q-10
	Additional NTMWD supplies	2020	2,702	$0	$1.75	$1.75	None

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Farmersville	Conservation	2020	46	$25,355	$0.81	$0.00	Q-10
	Additional NTMWD supplies	2020	922	$0	$1.70	$1.70	None
Frisco*	Conservation	2020	4,238	$1,829,608	$1.03	$0.47	Q-10
	Direct reuse	2020	5,650	$34,882,048	$2.27	$0.68	Q-74
	Additional NTMWD supplies	2020	21,752	$0	$1.70	$1.70	None
Garland*	Conservation	See Dallas County.					
	Other measures	See Garland in Section 5C.2.					
Hickory Creek SUD* (Region C Portion Only)	Conservation	See Fannin County.					
Josephine*	Conservation	2020	13	$6,573	$0.84	$0.00	Q-10
	Additional NTMWD supplies	2020	339	$0	$1.75	$1.75	None
Lavon	Conservation	2020	141	$13,820	$3.36	$0.00	Q-10
	Additional NTMWD supplies	2020	2,827	$0	$1.75	$1.75	None
Lavon SUD*	Conservation	2020	78	$14,354	$0.74	$0.00	Q-10
	Additional NTMWD supplies	2020	1,568	$0	$1.75	$1.75	None
Lowry Crossing	Conservation	2020	6	$4,120	$0.53	$0.00	Q-10
	Additional NTMWD supplies (though Milligan WSC)	2020	123	$0	$2.50	$2.50	None
Lucas	Conservation	2020	386	$62,579	$2.67	$0.79	Q-10
	Additional NTMWD supplies	2020	1,260	$0	$1.75	$1.75	None
Marilee SUD*	Conservation	2020	18	$1,000,000	$32.10	$0.00	Q-10
	Additional Sherman (Grayson County WSP)	2030	134	$0	$2.50	$2.50	None
McKinney	Conservation	2020	3,837	$2,138,094	$3.45	$1.05	Q-10
	Additional NTMWD supplies	2020	28,616	$0	$1.70	$1.70	None

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Melissa	Conservation	2020	852	$56,132	$1.62	$0.48	Q-10
	Additional NTMWD supplies	2020	5,914	$0	$1.75	$1.75	None
	Treated water supply line from NTMWD	*2020*	*237*	$2,124,324	$2.69	$0.39	Q-75
	Additional NTMWD supplies (CGMA)	*2020*	*5,677*	See GTUA in Section 5C.1.			
Murphy	Conservation	2020	262	$216,786	$2.09	$0.78	Q-10
	Additional NTMWD supplies	2020	1,943	$0	$1.75	$1.75	None
Nevada	Conservation	2020	47	$1,628	$0.42	$0.00	Q-10
	Additional NTMWD supplies	2020	953	$0	$1.75	$1.75	None
New Hope	Conservation	2020	6	$3,332	$0.86	$0.00	Q-10
	Additional NTMWD supplies (through North Collin WSC)	2020	120	$0	$1.75	$1.75	None
North Collin WSC	Conservation	2020	29	$17,277	$0.63	$0.00	Q-10
	Additional NTMWD supplies	2020	590	$0	$1.75	$1.75	None
Parker	Conservation	2020	338	$119,273	$1.74	$0.46	Q-10
	Additional NTMWD supplies	2020	5,398	$0	$1.75	$1.75	None
	Increase delivery infrastructure from NTMWD	*2030*	*5,398*	$1,651,000	$0.13	$0.06	Q-76
Plano*	Conservation	2020	2,942	$1,689,481	$1.34	$0.35	Q-10
	Additional NTMWD supplies	2020	27,924	$0	$1.70	$1.70	None
Princeton	Conservation	2020	158	$21,181	$0.68	$0.00	Q-10
	Other measures	See Princeton in Section 5C.					
Prosper*	Conservation	2020	1,030	$245,098	$1.17	$0.38	Q-10
	Additional NTMWD supplies	2020	10,934	$0	$1.70	$1.70	None
	Increase delivery infrastructure from NTWMD	*2020*	*10,934*	$3,786,000	$0.22	$0.04	Q-77 & Q-78

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Richardson*	Conservation	See Dallas County.					
	Additional NTMWD supplies	See Dallas County.					
Royse City*	Conservation	See Rockwall County.					
	Additional NTMWD supplies	See Rockwall County.					
Sachse*	Conservation	See Dallas County.					
	Additional NTMWD supplies	See Dallas County.					
Seis Lagos UD	Conservation	2020	46	$150,585	$1.69	$0.41	Q-10
	Additional NTMWD supplies	2020	205	$0	$1.75	$1.75	None
St. Paul	Conservation	2020	7	$8,349	$1.07	$0.00	Q-10
	Additional NTMWD supplies	2020	140	$0	$1.75	$1.75	None
South Grayson WSC*	Conservation	See Grayson County.					
	NTMWD supplies (CGMA)	See Grayson County.					
	Grayson County WSP (Sherman)	See Grayson County.					
Weston	Conservation	2020	374	$38,948	$2.50	$0.00	Q-10
	New Wells in Woodbine Aquifer	2020	71	$824,000	$4.14	$1.15	Q-215
	NTMWD supplies	2020	18,301	$0	$1.75	$1.75	None
	Connect to NTMWD and supplies	*2020*	*18,301*	$27,130,000	$0.53	$0.15	Q-79
Wylie*	Conservation	2020	190	$1,130,695	$4.76	$0.00	Q-10
	Additional NTMWD supplies	2020	3,831	$0	$1.70	$1.70	None
Wylie Northeast SUD	Conservation	2020	42	$150,000	$19.26	$0.00	Q-10
	Additional NTMWD supplies	2020	839	$0	$1.75	$1.75	None
	Increase delivery infrastructure from NTWMD	*2020*	*979*	$4,250,000	$1.34	$0.23	Q-80
Collin County Irrigation	Conservation	2020	275	$0	$0.95	$0.95	Q-11

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Collin County Livestock	None	None					
Collin County Manufacturing	Conservation	2020	157	$0	$0.95	$0.95	Q-11
	Additional Ground-water (new wells)	2030	78	$402,800	$1.95	$0.61	Q-72
	Additional NTMWD supplies	2020	2,076	$0	$1.75	$1.75	None
Collin County Mining	None	None					
Collin County Steam Electric	Additional NTMWD supplies	2020	306	$0	$0.68	$0.68	None

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.38
Summary of Recommended Water Management Strategies for Collin County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	18,943	$11,757,301
Purchase from WWP	198,055	$16,314,000
Delivery Infrastructure	*48,471*	$45,880,980
Direct Reuse	5,650	$34,882,048
Groundwater	149	$1,226,800
Total		**$110,061,129**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

Table 5D.39
Summary of Alternative Water Management Strategies for Collin County Not Covered Under Wholesale Water Providers

Type of Strategy	Entity	Quantity (Ac-Ft/Yr)	Capital Costs
Grayson County Water Supply Project (Sherman WTP)	Anna	10,954	See Gainesville in Section 5C.2
Total			**$0**

COLLIN COUNTY

2010 Population: 782,341

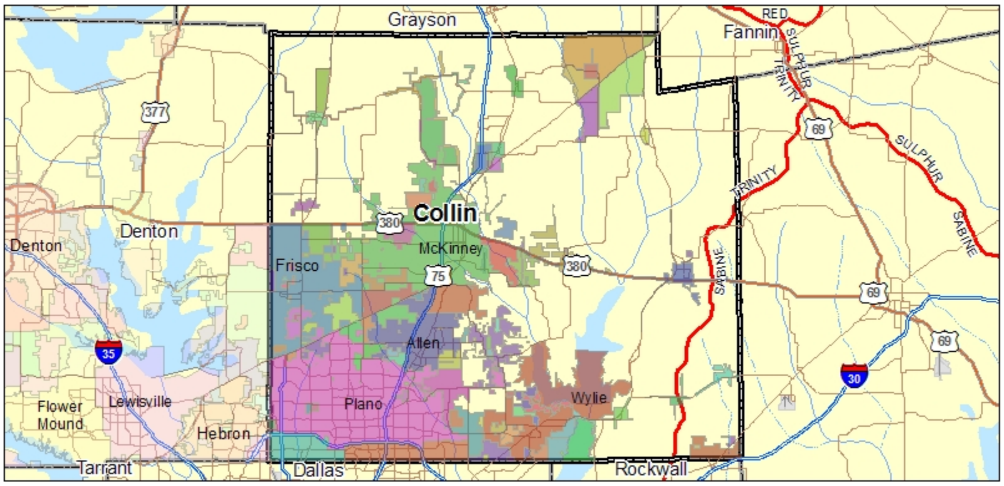
Projected 2070 Population: *2,053,638*

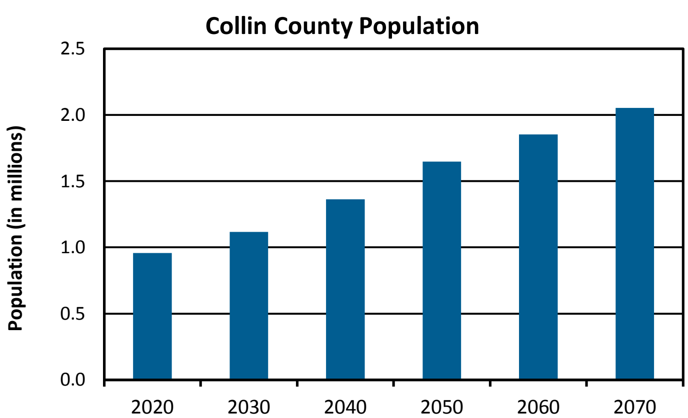
County Seat: McKinney

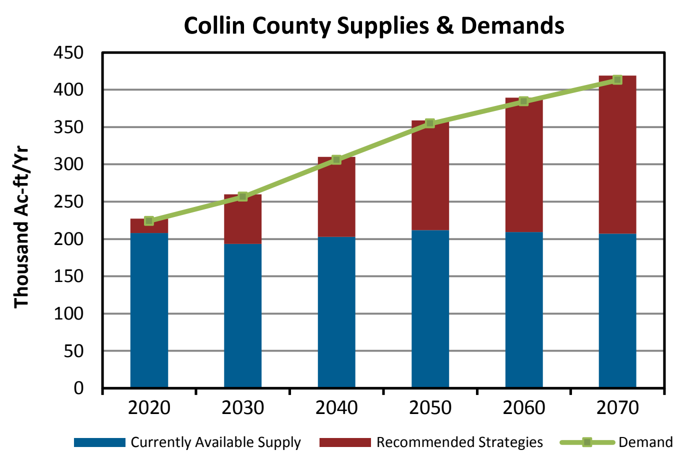
Economy: Government/services; manufacturing; retail and wholesale

River Basin(s):

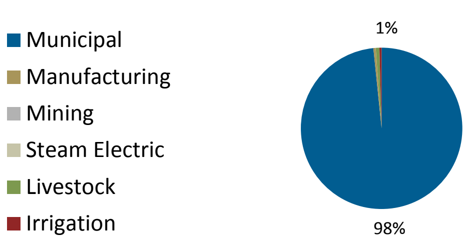
– Trinity (94%), Sabine (6%)





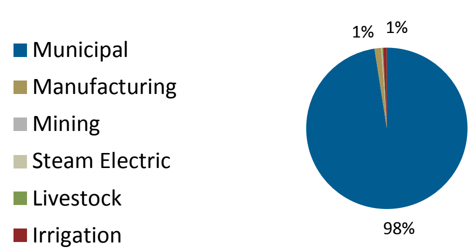


2010 Collin County Historical Demand
(% of total)



Total=167,304 acre-feet

2070 Collin County Projected Demand
(% of total)



Total= 412,735 acre-feet

5D.2 Cooke County

Figure 5D.2 is a map of Cooke County. The Trinity aquifer provides most of the water currently used in the county. Cooke County is in the North Texas Groundwater Conservation District. The other significant source of supply currently in use in Cooke County is Gainesville's surface water supply from Moss Lake. The projected demands in the county are greater than the estimated long-term reliable groundwater supply (modeled available groundwater). Recommended water management strategies to meet demands in Cooke County include the following:

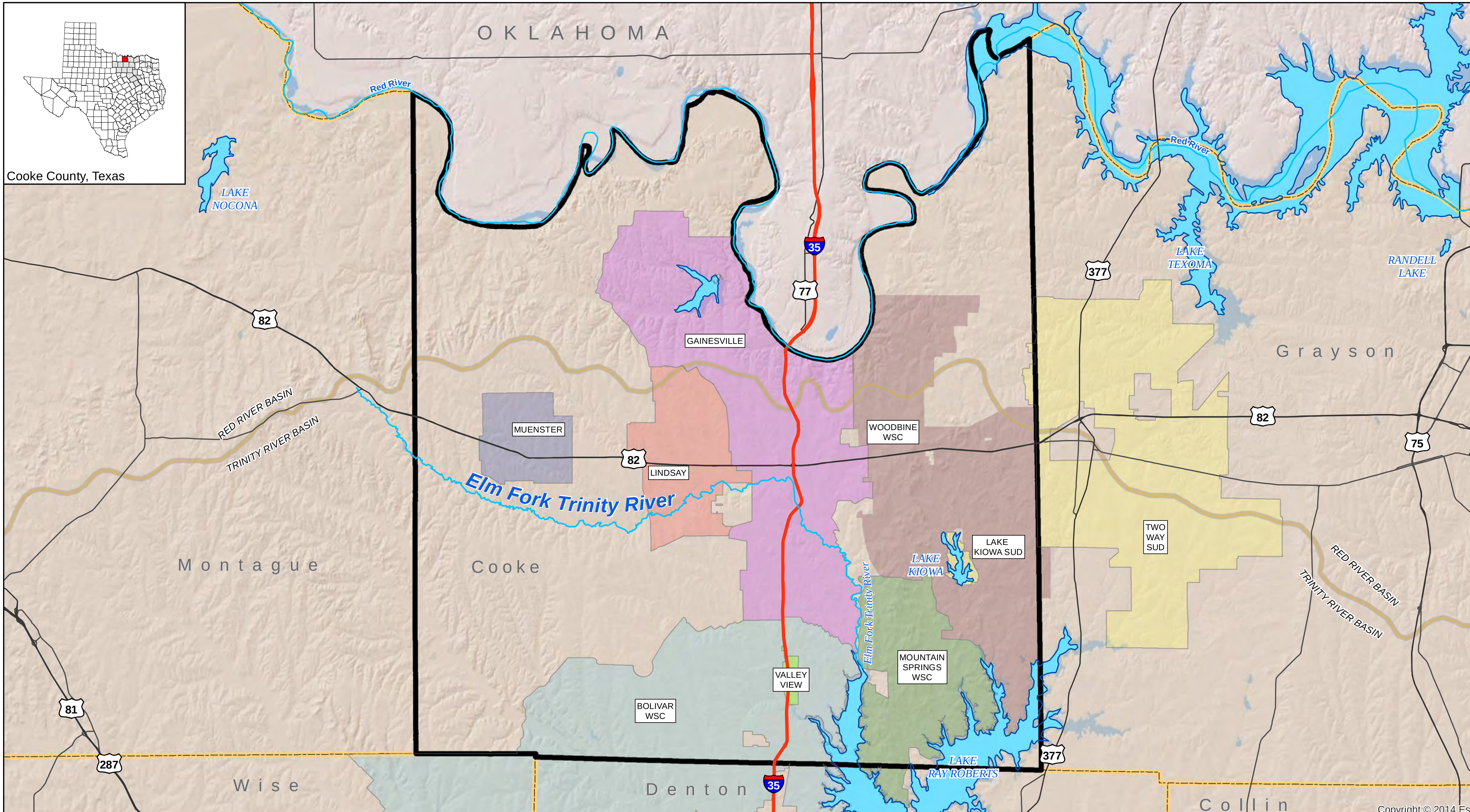
- Construction of transmission and treatment facilities to use water from Lake Muenster by the City of Muenster
- Development of a county-wide water delivery system by Gainesville, with possible assistance from Greater Texoma Utility Authority. This project would consist of additional raw water transmission facilities from Moss Lake, treatment plant expansions for Gainesville, and treated water pipelines to deliver water to users throughout the county. (In the previous plan, this project was referred to as the Cooke County Water Supply Project.)
- Supplies purchased from Gainesville
- Supplies purchased from the Upper Trinity Regional Water District.

As part of the strategy to serve multiple WUGs in Cooke County, Gainesville is assumed to develop additional supplies from Moss Lake before 2060 by building new raw water delivery facilities and expanding its water treatment plant. Further treatment plant and raw water delivery expansions will be needed before 2070. This strategy will provide treated surface water from Moss Lake to multiple water suppliers in Cooke County. It is discussed in Section 5C of this report under the City of Gainesville. This county-wide water delivery system will be developed by a combination of Gainesville, Greater Texoma Utility Authority, and other suppliers in the county. For this plan, the capital costs ($26 million) are included under Gainesville in Section 5C.

Water management strategies for Cooke County water user groups are discussed below (in alphabetical order). The costs for Cooke County water user groups are summarized in Table 5D.51, Table 5D.52, and Table 5D.53, followed by a summary for Cooke County.

Bolivar Water Supply Corporation

Bolivar WSC serves retail customers in southern Cooke County and in Denton and Wise Counties. Plans for Bolivar WSC are covered under Denton County in Section 5D.4.



FREESE AND NICHOLS

Project No: NTD11336

Service Area

County Boundary

Cooke County Boundary

River Basin Divide

Stream

Reservoir

N S E W

1 inch = 4.5 miles

0 2.25 4.5 9

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Cooke County, Texas

Figure 5D.2

Cooke County Irrigation

Cooke County Irrigation is supplied from groundwater (Trinity aquifer and Woodbine aquifer), direct reuse and Gainesville (Lake Moss). The water management strategy to develop additional supplies for irrigation is additional supplies from Gainesville. Table 5D.40 shows the projected demand, the current supplies, and the water management strategies for Cooke County Irrigation. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, locations, and types of irrigation that make up this WUG.

Table 5D.40
Projected Demand, Current Supplies and
Water Management Strategies for Cooke County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**300**	**300**	**300**	**300**	**300**	**300**
Currently Available Water Supplies						
Trinity Aquifer	176	176	176	176	176	176
Woodbine Aquifer	49	49	49	49	49	49
Direct Reuse (Gainesville)	9	9	9	9	9	9
Total Current Supplies	***234***	***234***	***234***	***234***	***234***	***234***
Need (Demand - Current Supply)	***66***	***66***	***66***	***66***	***66***	***66***
Water Management Strategies						
Additional Gainesville	70	70	70	70	70	70
Total Water Management Strategies	***70***	***70***	***70***	***70***	***70***	***70***
Reserve (Shortage)	**4**	**4**	**4**	**4**	**4**	**4**

Cooke County Livestock

Table 5D.41 shows the projected demand, the current supplies, and the water management strategies for Cooke County Livestock. As the table shows, current supplies are from the Trinity and Woodbine aquifers and local supplies. These supplies are sufficient to meet the projected demand. There are no water management strategies for this WUG.

Table 5D.41
Projected Demand, Current Supplies and
Water Management Strategies for Cooke County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**1,494**	**1,494**	**1,494**	**1,494**	**1,494**	**1,494**
Currently Available Water Supplies						
Trinity Aquifer	307	307	307	307	307	307
Woodbine Aquifer	60	60	60	60	60	60
Local Supplies	1,187	1,187	1,187	1,187	1,187	1,187
Total Current Supplies	***1,554***	***1,554***	***1,554***	***1,554***	***1,554***	***1,554***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**60**	**60**	**60**	**60**	**60**	**60**

Cooke County Manufacturing

Cooke County manufacturing is currently supplied from the Trinity aquifer and surface water provided through Gainesville. Water management strategies include conservation and additional supply from Gainesville. Table 5D.42 shows the projected demand, the current supplies, and the water management strategies for Cooke County Manufacturing.

Table 5D.42
Projected Demand, Current Supplies and
Water Management Strategies for Cooke County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**226**	**247**	**268**	**286**	**310**	**336**
Currently Available Water Supplies						
Trinity Aquifer	34	34	34	34	34	34
Gainesville	192	213	234	252	276	124
Total Current Supplies	***226***	***247***	***268***	***286***	***310***	***158***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***178***
Water Management Strategies						
Water Conservation	0	0	5	8	8	9

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Additional Gainesville	0	0	0	0	0	169
Total Water Management Strategies	***0***	***0***	***5***	***8***	***8***	***178***
Reserve (Shortage)	**0**	**0**	**5**	**8**	**8**	**0**

Cooke County Mining

Cooke County Mining is currently supplied from the Trinity aquifer. Water management strategies to develop additional supplies for Cooke County Mining include direct reuse and supplies from Gainesville. Table 5D.43 shows the projected demand, the current supplies, and the water management strategies for Cooke County Mining. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG. A reuse strategy has been recommended in lieu of a conservation strategy.

Table 5D.43
Projected Demand, Current Supplies and
and Water Management Strategies for Cooke County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,583**	**900**	**378**	**446**	**511**	**586**
Currently Available Water Supplies						
Trinity Aquifer	800	750	300	300	300	300
Total Current Supplies	***800***	***750***	***300***	***300***	***300***	***300***
Need (Demand - Current Supply)	***783***	***150***	***78***	***146***	***211***	***286***
Water Management Strategies						
Direct Reuse	99	67	71	74	77	80
Connect to Gainesville	684	83	7	72	134	206
Total Water Management Strategies	***783***	***150***	***78***	***146***	***211***	***286***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Cooke County Other

The entities included under Cooke County Other currently receive their water supply from groundwater (Trinity and Woodbine aquifers) and Gainesville provides some supply to areas outside the city which are included in this County Other demand. Based on TWDB groundwater pumping records, it is assumed that Cooke County Other's current groundwater pumping capacity in the Trinity is sufficient to pump the ultimate amount shown from the Trinity in the table below, but this pumping will not reach this higher level until needed in 2040. Water management strategies for these entities include conservation and additional entities connecting to Gainesville. Table 5D.44 shows the projected population and demand, the current supplies, and the water management strategies for Cooke County Other.

Table 5D.44
Projected Population and Demand, Current Supplies and
and Water Management Strategies for Cooke County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**8,500**	**9,000**	**9,724**	**13,000**	**15,000**	**31,000**
Projected Water Demand						
Municipal Demand	1,123	1,149	1,209	1,590	1,830	3,767
Total Projected Water Demand	***1,123***	***1,149***	***1,209***	***1,590***	***1,830***	***3,767***
Currently Available Water Supplies						
Trinity Aquifer	916	966	1,416	1,416	1,416	1,416
Woodbine Aquifer	45	45	45	45	45	45
Gainesville	162	138	0	129	369	951
Total Current Supplies	***1,123***	***1,149***	***1,461***	***1,590***	***1,830***	***2,412***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***1,355***
Water Management Strategies						
Water Conservation	9	13	12	21	31	75
Additional Gainesville	0	0	0	0	0	1,280
Total Water Management Strategies	***9***	***13***	***12***	***21***	***31***	***1,355***
Reserve (Shortage)	**9**	**13**	**264**	**21**	**31**	**0**

Cooke County Steam Electric Power

There is no projected demand for Cooke County Steam Electric Power.

Gainesville

Gainesville is the county seat of Cooke County and has a population of about 17,000. Gainesville is a wholesale water provider, and there is a detailed discussion of water supply plans for the city in Section 5C.2.

Lake Kiowa Special Utility District

Lake Kiowa SUD serves about 2,100 people around Lake Kiowa in eastern Cooke County. The WSC currently gets its water supply from groundwater (Trinity aquifer). Water management strategies for Lake Kiowa SUD are conservation and connecting to Gainesville. Table 5D.45 shows the projected population and demand, the current supplies, and the water management strategies for Lake Kiowa SUD.

Table 5D.45
Projected Population and Demand, Current Supplies and
and Water Management Strategies for Lake Kiowa Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,209**	**2,247**	**2,286**	**2,325**	**2,363**	**2,363**
Projected Water Demand						
Municipal Demand	786	790	800	813	826	826
Total Projected Water Demand	***786***	***790***	***800***	***813***	***826***	***826***
Currently Available Water Supplies						
Trinity Aquifer	829	829	829	829	829	829
Total Current Supplies	***829***	***829***	***829***	***829***	***829***	***829***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	7	9	8	11	14	17
Connect to Gainesville	0	100	100	100	100	100
Total Water Management Strategies	***7***	***109***	***108***	***111***	***114***	***117***
Reserve (Shortage)	**50**	**148**	**137**	**127**	**117**	**120**

Lindsay

Lindsay is a city of about 1,000 people in central Cooke County. The city currently receives its water supply from the Trinity aquifer. Water management strategies for Lindsay are conservation and connecting to Gainesville. Table 5D.46 shows the projected population and demand, the current supplies, and the water management strategies for Lindsay.

Table 5D.46
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Lindsay

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,102**	**1,183**	**1,245**	**1,307**	**2,500**	**5,000**
Projected Water Demand						
Municipal Demand	144	150	154	160	304	605
Total Projected Demand	***144***	***150***	***154***	***160***	***304***	***605***
Currently Available Water Supplies						
Trinity Aquifer	158	158	158	158	158	158
Total Current Supplies	***158***	***158***	***158***	***158***	***158***	***158***
Need (Demand - Current Supply)	***0***	***0***	***0***	***2***	***146***	***447***
Water Management Strategies						
Water Conservation	1	2	2	2	5	12
Connect to Gainesville	0	0	0	0	141	435
Total Water Management Strategies	***1***	***2***	***2***	***2***	***146***	***447***
Reserve (Shortage)	**15**	**10**	**6**	**0**	**0**	**0**

Mountain Spring Water Supply Corporation

Mountain Spring WSC serves about 2,500 people in southeastern Cooke County. The WSC currently receives its water supply from the Trinity aquifer. Water management strategies for Mountain Spring WSC are conservation and connecting to Gainesville. Table 5D.47 shows the projected population and demand, the current supplies, and the recommended water management strategies for Mountain Spring WSC.

Table 5D.47
Projected Population and Demand, Current Supplies and Water Management Strategies for the Mountain Spring Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,709**	**2,909**	**3,066**	**3,221**	**5,084**	**8,094**
Projected Water Demand						
Municipal Demand	456	480	499	520	816	1,296
Total Projected Demand	***456***	***480***	***499***	***520***	***816***	***1,296***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Trinity Aquifer	520	520	520	520	520	520
Total Current Supplies	***520***	***520***	***520***	***520***	***520***	***520***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***296***	***776***
Water Management Strategies						
Water Conservation	4	5	5	7	14	26
Connect to Gainesville	0	0	0	0	282	750
Total Water Management Strategies	***4***	***5***	***5***	***7***	***296***	***776***
Reserve (Shortage)	**68**	**45**	**26**	**7**	**0**	**0**

Muenster

The City of Muenster has a population of about 1,500 people in western Cooke County. The city currently receives its water supply from the Trinity aquifer. Water management strategies for Muenster are conservation and construction of a water treatment plant at Muenster Lake to begin utilizing Muenster Lake supply. Connecting to Gainesville as part of the county-wide supply system is an alternative water management strategy for Muenster. Table 5D.48 shows the projected population and demand, the current supplies, and the recommended and alternative water management strategies for Muenster.

Table 5D.48
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Muenster

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,550**	**1,550**	**1,600**	**1,600**	**1,650**	**1,650**
Projected Water Demand						
Municipal Demand	266	259	261	258	265	265
Total Projected Demand	***266***	***259***	***261***	***258***	***265***	***265***
Currently Available Water Supplies						
Trinity Aquifer	283	283	283	283	283	283
Total Current Supplies	***283***	***283***	***283***	***283***	***283***	***283***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	5	7	10	11
New 0.5 MGD WTP at Muenster Lake	280	280	280	280	280	280
Total Water Management Strategies	***282***	***283***	***285***	***287***	***290***	***291***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Reserve (Shortage)	**299**	**307**	**307**	**312**	**308**	**309**
Alternative Water Management Strategy						
Connect to Gainesville	280	280	280	280	280	280

Two Way Special Utility District

Two Way SUD serves about 4,900 people in eastern Cooke County and western Grayson County. Since most of the service area is in Grayson County, Two Way SUD is discussed under Grayson County in Section 5D.8.

Valley View

Valley View has a population of about 800 and is located in southern Cooke County. The city currently receives its water supply from the Trinity aquifer. Water management strategies for Valley View are conservation and connecting to Gainesville. Table 5D.49 shows the projected population and demand, the current supplies, and the recommended water management strategies for Valley View.

Table 5D.49
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Valley View

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**820**	**880**	**926**	**972**	**1,010**	**1,043**
Projected Water Demand						
Municipal Demand	56	60	63	66	68	71
Total Projected Demand	***56***	***60***	***63***	***66***	***68***	***71***
Currently Available Water Supplies						
Trinity Aquifer	56	56	56	56	56	56
Total Current Supplies	***56***	***56***	***56***	***56***	***56***	***56***
Need (Demand - Current Supply)	***0***	***4***	***7***	***10***	***12***	***15***
Water Management Strategies						
Water Conservation	0	1	1	1	1	1
Connect to Gainesville	0	3	6	9	11	14
Total Water Management Strategies	***0***	***4***	***7***	***10***	***12***	***15***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Woodbine Water Supply Corporation

Woodbine WSC serves about 5,700 people in eastern Cooke County and western Grayson County. The WSC currently receives its water supply from the Trinity aquifer. Water management strategies for Woodbine WSC are conservation and connecting to Gainesville. Table 5D.50 shows the projected population and demand, the current supplies, and the recommended water management strategies for Woodbine WSC.

Table 5D.50
Projected Population and Demand, Current Supplies
and Water Management Strategies for the Woodbine Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,215**	**7,040**	**7,865**	**8,690**	**9,515**	**10,340**
Projected Water Demand						
Municipal Demand	660	717	778	848	925	1,004
Total Projected Demand	***660***	***717***	***778***	***848***	***925***	***1,004***
Currently Available Water Supplies						
Trinity Aquifer	667	667	667	667	667	667
Total Current Supplies	***667***	***667***	***667***	***667***	***667***	***667***
Need (Demand - Current Supply)	***0***	***50***	***111***	***181***	***258***	***337***
Water Management Strategies						
Water Conservation	6	8	8	11	15	20
Connect to Gainesville	0	42	103	170	243	317
Total Water Management Strategies	***6***	***50***	***111***	***181***	***258***	***337***
Reserve (Shortage)	**13**	**0**	**0**	**0**	**0**	**0**

Costs for Cooke County Water User Groups

Table 5D.51 shows the estimated capital costs for Cooke County water management strategies not covered under the wholesale water providers, and Table 5D.52 summarizes the costs by category. Table 5D.53 shows the cost of the alternative strategy not covered under the wholesale water providers, and it is followed by a summary for Cooke County.

Table 5D.51
Costs for Recommended Water Management Strategies for Cooke County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Bolivar WSC*	Conservation	See Denton County.					
	UTRWD supplies	See Denton County.					
	Connect to Gainesville	See Denton County.					
Cooke County Other	Conservation	2020	75	$24,421	$0.70	$0.00	Q-10
	Connect to Gainesville	2020	1,280	See Gainesville in Section 5C.2.			
Gainesville	Conservation	2020	93	$225,921	$2.76	$0.00	Q-10
	Other measures	2020	See Gainesville in Section 5C.				
Lake Kiowa SUD	Conservation	2020	17	$107,958	$3.96	$0.00	Q-10
	Connect to Gainesville	2020	100	See Gainesville in Section 5C.2.			
Lindsay	Conservation	2020	12	$10,685	$2.74	$0.00	Q-10
	Connect to Gainesville	2020	435	See Gainesville in Section 5C.			
Mountain Spring WSC*	Conservation	2020	26	$11,183	$0.72	$0.00	Q-10
	Connect to Gainesville	2060	750	See Gainesville in Section 5C.2.			
Muenster	Conservation	2020	11	$21,182	$2.72	$1.33	Q-10
	Develop Muenster Lake supply	2020	280	$8,504,000	$13.48	$5.68	Q-85
Two Way SUD*	Conservation	See Grayson County.					
	Grayson County Water Supply Project (Northwest WTP)	See Grayson County.					
Valley View	Conservation	2020	1	$755	$0.00	$0.00	Q-10
	Connect to Gainesville	2020	14	See Gainesville in Section 5C.2.			
Woodbine WSC*	Conservation	2020	20	$23,732	$1.02	$0.00	Q-10
	Connect to Gainesville	2020	317	See Gainesville in Section 5C.2.			
Cooke County Irrigation	Additional Gainesville	2020	70	See Gainesville in Section 5C.2.			
Cooke County Livestock	None	None					
Cooke County Manufacturing	Conservation	2020	9	$0	$0.95	$0.95	Q-11
	Additional Gainesville	2070	169	See Gainesville in Section 5C.2.			
Cooke County Mining	Direct Reuse	2020	99	See Gainesville in Section 5C.2.			
	Connect to Gainesville	2020	684	See Gainesville in Section 5C.2.			

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.52
Summary of Recommended Water Management Strategies for Cooke County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	264	$425,837
Purchase from WWP	3,819	$0
Connect to Supplies (Lake Muenster)	280	$8,504,000
Reuse	99	$0
Total		**$8,929,837**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

Table 5D.53
Summary of Alternative Water Management Strategies for Cooke County Not Covered Under Wholesale Water Providers

Type of Strategy	Entity	Quantity (Ac-Ft/Yr)	Capital Costs
Connect to Gainesville	Muenster	280	$2,928,900
Total			**$2,928,900**

COOKE COUNTY

2010 Population: 38,437

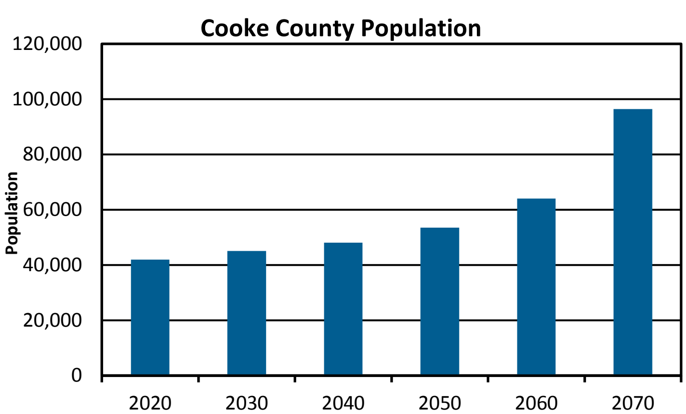
Projected 2070 Population: *96,463*

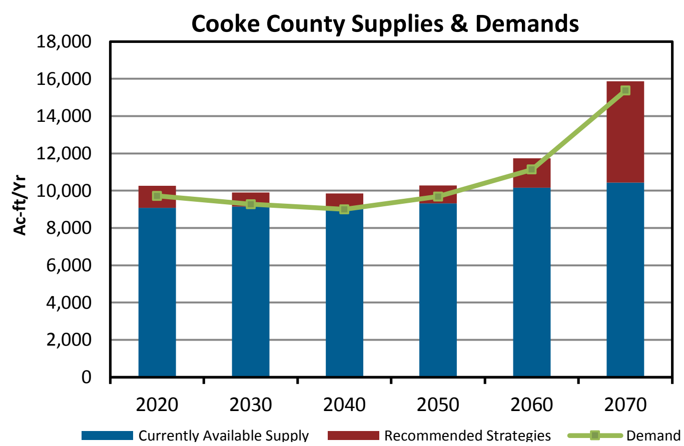
County Seat: Gainesville

Economy: *Oil, agribusiness, tourism, manufacturing*

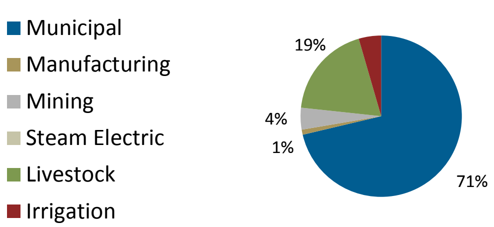
River Basin(s):

- *Trinity (67%), Red (32%)*



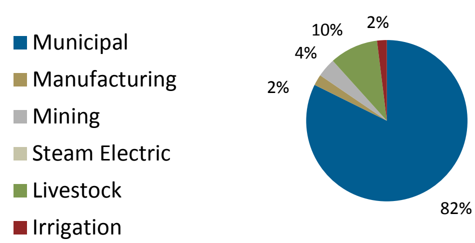


2010 Cooke County Historical Demand
(% of total)



Total=7,346 acre-feet

2070 Cooke County Projected Demand
(% of total)



Total= 15,366 acre-feet

5D.3 Dallas County

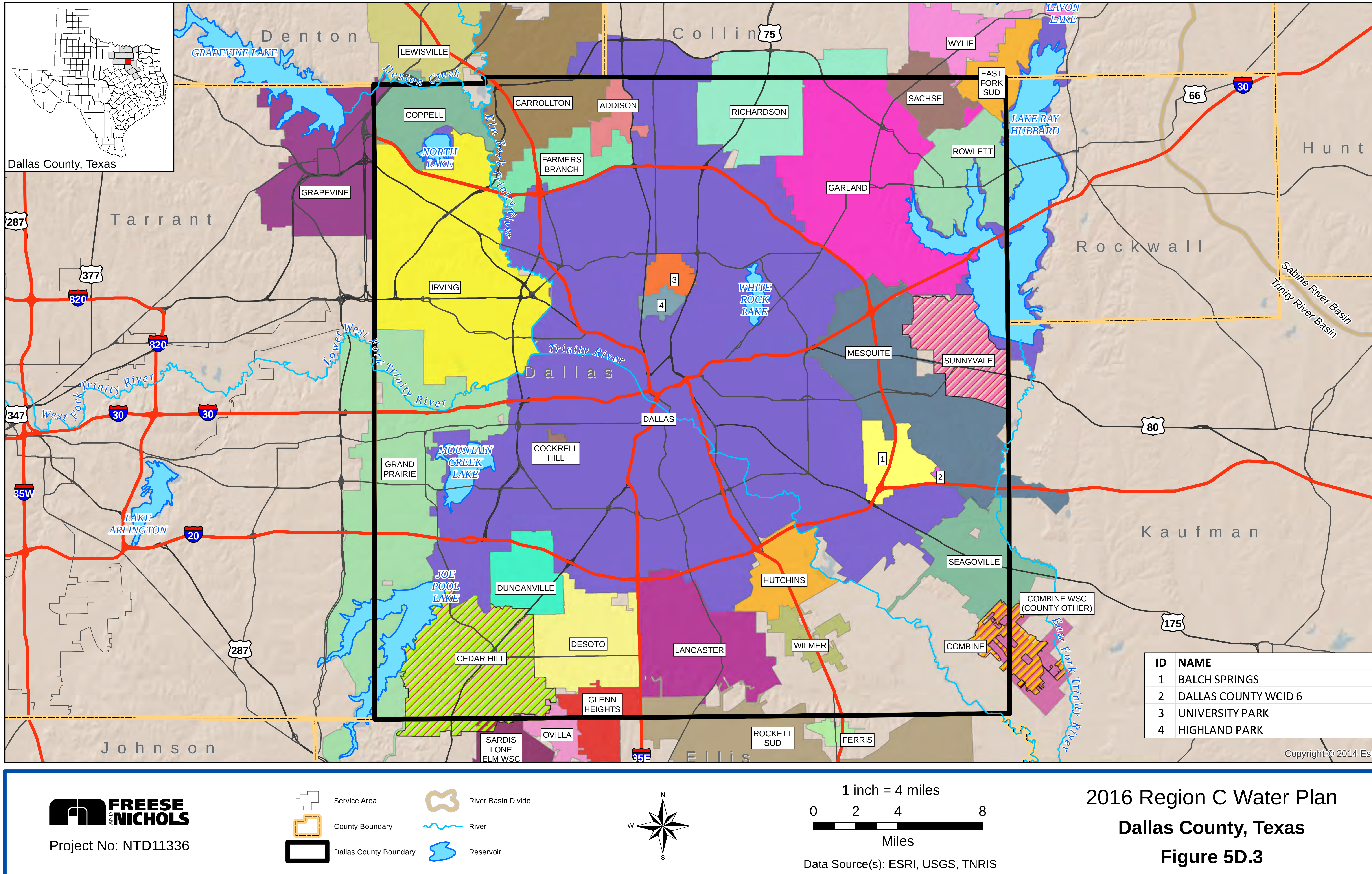
Figure 5D.3 is a map of Dallas County. Most demands in Dallas County are met by Dallas Water Utilities (DWU), with North Texas Municipal Water District (NTMWD) and Irving also providing major supplies. DWU, NTMWD, and Irving will continue to be the largest water providers in the county in the future. Along with additional supplies from DWU and NTMWD, other management strategies for Dallas County include the following:

- Conservation
- Supplies from Mansfield, Midlothian, and Arlington for Grand Prairie (all using raw water from Tarrant Regional Water District [TRWD])
- Reuse projects (Dallas, Irving, TRA)
- Supplies from the Waxahachie's Sokoll Water Treatment Plant in Ellis County (for suppliers primarily located in Ellis County). The raw water for these supplies comes from TRWD.

Water management strategies for Dallas County water user groups are discussed below (in alphabetical order). Table 5D.80 shows the estimated capital costs for the Dallas County water management strategies not associated with the wholesale water providers, and Table 5D.81 is a summary of the costs by category. Table 5D. 82 gives the costs of alternative strategies for Dallas County suppliers and is followed by a Dallas County summary.

Addison

The City of Addison has a population of about 15,000 and is located in northern Dallas County. The city receives its water supply from DWU. Water management strategies for Addison are conservation and additional water from DWU. Table 5D.54 shows the projected population and demand, the current supplies, and the recommended water management strategies for Addison.



2016 Region C Water Plan

Dallas County, Texas

Figure 5D.3

Table 5D.54
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Addison

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**14,539**	**17,431**	**20,323**	**23,215**	**26,107**	**29,000**
Projected Water Demand						
Municipal Demand	6,002	7,113	8,235	9,376	10,536	11,701
Total Projected Water Demand	***6,002***	***7,113***	***8,235***	***9,376***	***10,536***	***11,701***
Currently Available Water Supplies						
Dallas Water Utilities	5,723	6,168	6,377	6,694	7,036	7,443
Total Current Supplies	***5,723***	***6,168***	***6,377***	***6,694***	***7,036***	***7,443***
Need (Demand - Current Supply)	***279***	***945***	***1,858***	***2,682***	***3,500***	***4,258***
Water Management Strategies						
Water Conservation	110	184	247	313	386	468
Additional Water from DWU	169	761	1,611	2,369	3,114	3,790
Total Water Management Strategies	***279***	***945***	***1,858***	***2,682***	***3,500***	***4,258***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Balch Springs

The City of Balch Springs has a population of about 24,000. The city currently receives its water supply from DWU. In previous plans, Balch Springs was provided retail water service by Dallas County Water Control and Improvement District Number 6, which purchased water supply from DWU. Since the 2011 Plan, this district has been dissolved and Balch Springs now operates its own water system and purchases water directly from DWU. Water management strategies for Balch Springs are conservation and additional water from DWU. Table 5D.55 shows the projected population and demand, the current supplies, and the recommended water management strategies for Balch Springs.

Table 5D.55
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Balch Springs

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**26,423**	**28,980**	**31,606**	**34,456**	**37,233**	**40,018**
Projected Water Demand						
Municipal Demand	2,750	2,895	3,067	3,294	3,547	3,809
Total Projected Demand	***2,750***	***2,895***	***3,067***	***3,294***	***3,547***	***3,809***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Dallas Water Utilities	2,622	2,510	2,375	2,352	2,369	2,423
Total Current Supplies	***2,622***	***2,510***	***2,375***	***2,352***	***2,369***	***2,423***
Need (Demand - Current Supply)	***128***	***385***	***692***	***942***	***1,178***	***1,386***
Water Management Strategies						
Water Conservation	23	33	31	44	59	76
Additional DWU	105	352	661	898	1,119	1,310
Total Water Management Strategies	***128***	***385***	***692***	***942***	***1,178***	***1,386***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Carrollton

Carrollton is a city of about 124,000 people located in northwest Dallas County and southern Denton County. The water supply for Carrollton is discussed under Denton County in Section 5D.4.

Cedar Hill

The City of Cedar Hill has a population of about 46,000. It is located in southwest Dallas County, with a small part in Ellis County. Cedar Hill currently receives its water supply from the Trinity aquifer and DWU. Water management strategies for Cedar Hill are conservation, and additional water from DWU. Table 5D.56 shows the projected population and demand, the current supplies, and the recommended water management strategies for Cedar Hill.

Table 5D.56
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Cedar Hill

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**53,200**	**65,119**	**77,038**	**88,956**	**88,956**	**88,956**
Projected Water Demand						
Municipal Demand	10,652	12,808	15,005	17,244	17,229	17,227
Total Projected Demand	***10,652***	***12,808***	***15,005***	***17,244***	***17,229***	***17,227***
Currently Available Water Supplies						
Trinity Aquifer	180	180	180	180	180	180
Dallas Water Utilities	9,985	10,951	11,481	12,183	11,386	10,843
Total Current Supplies	***10,165***	***11,131***	***11,661***	***12,363***	***11,566***	***11,023***
Need (Demand - Current Supply)	***487***	***1,677***	***3,344***	***4,881***	***5,663***	***6,204***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	211	374	505	641	697	755
Additional Water from DWU	276	1,303	2,839	4,240	4,966	5,449
Total Water Management Strategies	***487***	***1,677***	***3,344***	***4,881***	***5,663***	***6,204***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Cockrell Hill

The City of Cockrell Hill has a population of about 4,200 people in western Dallas County. The city receives its water supply from DWU. Water management strategies for Cockrell Hill are conservation and additional water from DWU. Table 5D.57 shows the projected population and demand, the current supplies, and the recommended water management strategies for Cockrell Hill.

Table 5D.57
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Cockrell Hill

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,670**	**5,122**	**5,122**	**5,122**	**7,000**	**15,000**
Projected Water Demand						
Municipal Demand	407	421	405	396	536	1,141
Total Projected Demand	***407***	***421***	***405***	***396***	***536***	***1,141***
Currently Available Water Supplies						
Dallas Water Utilities	388	365	314	283	358	726
Total Current Supplies	***388***	***365***	***314***	***283***	***358***	***726***
Need (Demand - Current Supply)	***19***	***56***	***91***	***113***	***178***	***415***
Water Management Strategies						
Water Conservation	3	5	4	5	9	23
Additional Water from DWU	16	51	87	108	169	392
Total Water Management Strategies	***19***	***56***	***91***	***113***	***178***	***415***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Combine

Combine has a population of about 2,000 people and is located in southeast Dallas County and western Kaufman County. The water supply for Combine is discussed under Kaufman County in Section 5D.11.

Coppell

The City of Coppell has a population of about 39,000 and is located in northwest Dallas County with a small area in Denton County. Coppell currently receives its water supply from DWU. Water management strategies for Coppell are conservation and additional water from DWU. Table 5D.58 shows the projected population and demand, the current supplies, and the recommended water management strategies for Coppell.

Table 5D.58
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Coppell

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**41,460**	**42,953**	**42,953**	**42,953**	**42,953**	**42,953**
Projected Water Demand						
Municipal Demand	10,992	11,245	11,146	11,089	11,075	11,074
Total Projected Demand	***10,992***	***11,245***	***11,146***	***11,089***	***11,075***	***11,074***
Currently Available Water Supplies						
Dallas Water Utilities	10,481	9,751	8,632	7,917	7,396	7,044
Total Current Supplies	***10,481***	***9,751***	***8,632***	***7,917***	***7,396***	***7,044***
Need (Demand - Current Supply)	***511***	***1,494***	***2,514***	***3,172***	***3,679***	***4,030***
Water Management Strategies						
Water Conservation	202	299	334	370	406	443
Additional Water from DWU	309	1,195	2,180	2,802	3,273	3,587
Total Water Management Strategies	***511***	***1,494***	***2,514***	***3,172***	***3,679***	***4,030***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Dallas

Dallas Water Utilities (DWU) is the water utility of the City of Dallas, which has a population of about 1,230,000. DWU is a wholesale water provider. The City of Dallas is primarily in Dallas County but extends into Collin, Denton, and Rockwall Counties. There is a detailed discussion of water supply plans for DWU in Section 5C.1.

Dallas County Irrigation

Table 5D.59 shows the projected demand, the current supplies, and the water management strategies for Dallas County Irrigation. Golf course irrigation is the largest part of the irrigation water use in Dallas County. (The Texas Water Development classifies the use of potable water for golf course irrigation as a part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.) As shown in Table 5D.59, DWU, local supplies, indirect reuse, Joe Pool Lake, and groundwater all provide water for irrigation in Dallas County. Water management strategies include conservation and additional TRA indirect reuse for Los Colinas.

Table 5D.59
Projected Demand, Current Supplies
and Water Management Strategies for the Dallas County Irrigation

(Values in Ac-Ft/Yr)	**Projected Demand**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**9,134**	**9,134**	**9,134**	**9,134**	**9,134**	**9,134**
Currently Available Water Supplies						
DWU Direct Reuse Sources	490	490	490	490	490	490
Local Supplies	791	791	791	791	791	791
Trinity Aquifer	1,587	1,587	1,587	1,587	1,587	1,587
Woodbine Aquifer	1,372	1,372	1,372	1,372	1,372	1,372
TRA Indirect Reuse (Las Colinas)	8,000	8,000	8,000	8,000	8,000	8,000
TRA Indirect Reuse (Ten Mile WWTP)	125	125	125	125	125	125
Joe Pool Lake (Grand Prairie)	300	300	300	300	300	300
Total Current Supplies	***12,665***	***12,665***	***12,665***	***12,665***	***12,665***	***12,665***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	18	294	565	708	841	975
Additional TRA Las Colinas	0	7,000	7,000	7,000	7,000	7,000
Total Water Management Strategies	***18***	***7,294***	***7,565***	***7,708***	***7,841***	***7,975***
Reserve (Shortage)	**3,549**	**10,825**	**11,096**	**11,239**	**11,372**	**11,506**

Dallas County Livestock

Table 5D.60 shows the projected demand and the current supplies for Dallas County Livestock. The current supplies for Dallas County Livestock are local surface water supplies and Woodbine aquifer supplies. The current sources are sufficient to meet future demands, and there are no water management strategies.

Table 5D.60
Projected Demand, Current Supplies
and Water Management Strategies for Dallas County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**854**	**854**	**854**	**854**	**854**	**854**
Currently Available Water Supplies						
Local supplies	198	198	198	198	198	198
Woodbine Aquifer	763	763	763	763	763	763
Total Current Supplies	***961***	***961***	***961***	***961***	***961***	***961***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Total Water Management Strategies						
None	0	0	0	0	0	0
Reserve (Shortage)	**107**	**107**	**107**	**107**	**107**	**107**

Dallas County Manufacturing

Table 5D.61 shows the projected demand, the current supplies, and the water management strategies for Dallas County Manufacturing. Most manufacturing in Dallas County is supplied by DWU and NTMWD, with additional supplies from Irving, Grand Prairie, and groundwater (Trinity and Woodbine aquifers). Conservation and additional supplies from DWU, NTMWD, and Grand Prairie are the water management strategies to meet projected demands.

Table 5D.61
Projected Demand, Current Supplies
and Water Management Strategies for the Dallas County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**37,791**	**41,148**	**44,214**	**46,703**	**46,983**	**47,265**
Currently Available Water Supplies						
Dallas Water Utilities	27,213	27,008	25,371	24,526	23,058	22,097
North Texas Municipal Water District	3,482	3,153	3,122	3,109	2,931	2,729
Irving (Lake Chapman)	3,779	4,115	4,421	4,670	4,698	4,727
Grand Prairie	692	673	611	563	518	494
Trinity Aquifer	530	530	530	530	530	530
Woodbine Aquifer	43	43	43	43	43	43
Total Current Supplies	***35,739***	***35,522***	***34,098***	***33,441***	***31,778***	***30,620***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***2,052***	***5,626***	***10,116***	***13,262***	***15,205***	***16,645***
Water Management Strategies						
Water Conservation	0	80	917	1,316	1,367	1,379
Additional Water from DWU	1,327	4,137	7,390	9,827	11,469	12,643
Additional Water from NTMWD	297	962	1,299	1,561	1,767	1,997
Additional Water from Grand Prairie	429	448	510	558	603	627
Total Water Management Strategies	***2,052***	***5,626***	***10,116***	***13,262***	***15,206***	***16,645***
Reserve (Shortage)	**1**	**1**	**0**	**0**	**1**	**1**

Dallas County Mining

Table 5D.62 shows the projected demand, the current supplies, and the water management strategies for Dallas County Mining. Dallas County Mining is supplied from DWU, local supplies, and groundwater (Trinity aquifer). The water management strategy for this water user group is additional supplies from DWU. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5D.62
Projected Demand, Current Supplies
and Water Management Strategies for the Dallas County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**3,038**	**2,656**	**2,279**	**1,930**	**1,922**	**1,916**
Currently Available Water Supplies						
DWU Sources	1,012	589	234	138	128	122
Local Supplies	1,525	1,525	1,525	1,525	1,525	1,525
Trinity Aquifer	452	452	452	452	452	452
Total Current Supplies	***2,989***	***2,566***	***2,211***	***2,115***	***2,105***	***2,099***
Need (Demand - Current Supply)	***49***	***90***	***68***	***0***	***0***	***0***
Water Management Strategies						
Additional Water from DWU	49	90	68	55	64	70
Total Water Management Strategies	***49***	***90***	***68***	***55***	***64***	***70***
Reserve (Shortage)	**0**	**0**	**0**	**240**	**247**	**253**

Dallas County Other

Dallas County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. Dallas County Other also includes the Dallas-Fort Worth International Airport. The municipal entities included under Dallas County Other currently receive their water supply from either groundwater (Trinity and Woodbine aquifers), DWU, Tarrant Regional Water District, or Fort Worth reuse sources. The Dallas-Fort Worth International Airport is supplied by both Fort Worth and Dallas. Water management strategies for these entities, including Dallas-Fort Worth International Airport, are: conservation, additional supplies from Dallas, and additional supplies from Fort Worth and TRWD. Table 5D.63 shows the projected population and demand, the current supplies, and the water management strategies for Dallas County Other.

Table 5D.63
Projected Population and Demand, Current Supplies and Water Management Strategies for Dallas County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**5,339**	**3,000**	**2,000**	**2,000**	**2,000**	**2,000**
Projected Water Demand						
Municipal Demand	3,106	2,622	2,415	2,414	2,413	2,413
Total Projected Water Demand	***3,106***	***2,622***	***2,415***	***2,414***	***2,413***	***2,413***
Currently Available Water Supplies						
Trinity Aquifer	205	205	205	205	205	205
Woodbine Aquifer	56	56	56	56	56	56
Dallas	803	310	117	107	100	95
Dallas (for DFW Airport)	1,146	1,042	775	715	668	637
TRWD sources for DFW Airport (thru Ft Worth)	761	614	582	524	480	441
Ft Worth Reuse Sources for DFW Airport	40	40	151	151	151	151
Total Current Supplies	***3,011***	***2,267***	***1,886***	***1,758***	***1,660***	***1,585***
Need (Demand - Current Supply)	***95***	***355***	***529***	***656***	***753***	***828***
Water Management Strategies						
Water Conservation	14	15	6	9	11	13
Add'l Dallas	39	48	34	43	49	54
Add'l Dallas for DFW Airport	56	160	226	286	333	364
Add'l Ft Worth/TRWD for DFW Airport	40	187	420	478	522	561

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Water Management Strategies	***149***	***410***	***686***	***816***	***915***	***992***
Reserve (Shortage)	**54**	**55**	**157**	**160**	**162**	**164**

Dallas County Steam Electric Power

Table 5D.64 shows the projected demand, the current supplies, and the water management strategies for Dallas County Steam Electric Power. Dallas County Steam Electric Power is currently supplied by DWU, Mountain Creek Lake, and run-of-the-river supplies. The water management strategies for this water user group are additional supplies from DWU and reuse from TRA. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.64
Projected Demand, Current Supplies
and Water Management Strategies for Dallas County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**5,000**	**5,000**	**11,066**	**11,066**	**11,066**	**11,066**
Currently Available Water Supplies						
Dallas Water Utilities	4,768	4,336	3,872	3,570	3,339	3,180
Mountain Creek Lake	6,400	6,400	6,400	6,400	6,400	6,400
Run-of-River	368	368	368	368	368	368
Total Current Supplies	***11,536***	***11,104***	***10,640***	***10,338***	***10,107***	***9,948***
Need (Demand - Current Supply)	***0***	***0***	***426***	***728***	***959***	***1,118***
Water Management Strategies						
Additional Water from DWU	232	664	1,128	1,430	1,661	1,820
Direct Reuse (TRA)	0	2,000	2,000	2,000	2,000	2,000
Total Water Management Strategies	***232***	***2,664***	***3,128***	***3,430***	***3,661***	***3,820***
Reserve (Shortage)	**6,768**	**8,768**	**2,702**	**2,702**	**2,702**	**2,702**

DeSoto

DeSoto is a city of about 50,500 people in southwestern Dallas County and receives its water supply from DWU. Water management strategies for DeSoto are conservation and additional water from DWU. Table 5D.65 shows the projected population and demand, the current supplies, and the water management strategies for DeSoto.

Table 5D.65
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of DeSoto

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**54,617**	**59,903**	**65,330**	**71,222**	**76,963**	**82,718**
Projected Water Demand						
Municipal Demand	9,442	10,128	10,878	11,765	12,687	13,628
Total Projected Demand	***9,442***	***10,128***	***10,878***	***11,765***	***12,687***	***13,628***
Currently Available Water Supplies						
Dallas Water Utilities	9,003	8,783	8,424	8,400	8,473	8,668
Total Current Supplies	***9,003***	***8,783***	***8,424***	***8,400***	***8,473***	***8,668***
Need (Demand - Current Supply)	***439***	***1,345***	***2,454***	***3,365***	***4,214***	***4,960***
Water Management Strategies						
Water Conservation	227	433	506	587	676	772
Additional Water from DWU	212	912	1,948	2,778	3,538	4,188
Total Water Management Strategies	***439***	***1,345***	***2,454***	***3,365***	***4,214***	***4,960***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Duncanville

Duncanville has a population of about 39,000 people and is located in southwestern Dallas County. The city receives its water supply from DWU. Water management strategies for Duncanville are conservation and additional water from DWU. Table 5D.66 shows the projected population and demand, the current supplies, and the water management strategies for Duncanville.

Table 5D.66
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Duncanville

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**42,927**	**47,106**	**47,106**	**47,106**	**47,106**	**47,106**
Projected Water Demand						
Municipal Demand	6,065	6,437	6,295	6,218	6,204	6,203
Total Projected Demand	***6,065***	***6,437***	***6,295***	***6,218***	***6,204***	***6,203***
Currently Available Water Supplies						
Dallas Water Utilities	5,783	5,582	4,875	4,439	4,143	3,946
Total Current Supplies	***5,783***	***5,582***	***4,875***	***4,439***	***4,143***	***3,946***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***282***	***855***	***1,420***	***1,779***	***2,061***	***2,257***
Water Management Strategies						
Water Conservation	51	73	63	83	103	124
Additional Water from DWU	231	782	1,357	1,696	1,958	2,133
Total Water Management Strategies	***282***	***855***	***1,420***	***1,779***	***2,061***	***2,257***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

East Fork Special Utility District

East Fork SUD is located in southern Collin County and extends into Dallas and Rockwall Counties. The water management strategies for East Fork SUD are described under Collin County in Section 5D.1.

Farmers Branch

Farmers Branch has a population of about 30,000 people in northwestern Dallas County. The city receives its water supply from DWU. As shown on Table 5D.67, water management strategies for Farmers Branch are conservation and additional water from DWU.

Table 5D.67
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Farmers Branch

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**30,613**	**32,509**	**34,455**	**36,567**	**38,625**	**40,689**
Projected Water Demand						
Municipal Demand	9,041	9,458	9,911	10,457	11,031	11,618
Total Projected Demand	***9,041***	***9,458***	***9,911***	***10,457***	***11,031***	***11,618***
Currently Available Water Supplies						
Dallas Water Utilities	8,621	8,202	7,675	7,466	7,367	7,390
Total Current Supplies	***8,621***	***8,202***	***7,675***	***7,466***	***7,367***	***7,390***
Need (Demand - Current Supply)	***420***	***1,256***	***2,236***	***2,991***	***3,664***	***4,228***
Water Management Strategies						
Water Conservation	215	398	456	519	588	661
Additional Water from DWU	205	858	1,780	2,472	3,076	3,567
Total Water Management Strategies	***420***	***1,256***	***2,236***	***2,991***	***3,664***	***4,228***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Garland

Garland is a city of about 232,000 in northeastern Dallas County. Garland is a wholesale water provider, and there is a discussion of Garland's water supply plans in Section 5C.2.

Glenn Heights

Glenn Heights is a city of about 11,400 people located in southern Dallas and northern Ellis Counties. Glenn Heights provides water for in-city municipal demand and provides wholesale water to the City of Oak Leaf. Glenn Heights gets its water supply from DWU and the Trinity and Woodbine aquifers. Water management strategies for Glenn Heights are conservation and additional water from DWU, including an increase in delivery infrastructure from Dallas. Table 5D.68 shows the projected population and demand, the current supplies, and the water management strategies for Glenn Heights.

Table 5D.68
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Glenn Heights

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population (In City Only)	**17,323**	**23,308**	**29,590**	**36,506**	**43,522**	**59,000**
Projected Water Demand						
Municipal Demand	1,897	2,479	3,107	3,810	4,533	6,136
Customer Demand (Oak Leaf)	100	110	131	207	330	413
Total Projected Demand	***1,997***	***2,589***	***3,238***	***4,017***	***4,863***	***6,549***
Currently Available Water Supplies						
Trinity Aquifer	94	94	94	94	94	94
Woodbine Aquifer	79	79	79	79	79	79
Dallas for Glenn Heights	1,644	2,095	2,373	2,745	3,132	4,056
Dallas for Oak Leaf	95	95	101	148	220	263
Total Current Supplies	***1,912***	***2,363***	***2,647***	***3,066***	***3,525***	***4,492***
Need (Demand - Current Supply)	***85***	***226***	***591***	***951***	***1,338***	***2,057***
Water Management Strategies						
Water Conservation	16	26	31	51	76	123
Water Conservation (customer)	1	2	2	3	6	9
Additional Dallas for Glenn Heights	64	185	530	841	1,152	1,784
Additional Dallas for Oak Leaf	4	13	28	56	104	141
Increase delivery infrastructure from DWU	*0*	*0*	*0*	*0*	*289*	*1,925*
Total Water Management Strategies	***85***	***226***	***591***	***951***	***1,338***	***2,057***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Grand Prairie

Grand Prairie is a city of about 181,000 in western Dallas County, eastern Tarrant County, and northwestern Ellis County. The city is a wholesale water provider, and there is a discussion of Grand Prairie's water supply plans in Section 5C.2.

Highland Park

Highland Park is a city of about 8,500 people in central Dallas County and receives its water supply from the Dallas County Park Cities MUD. The only water management strategy for Highland Park is conservation. Table 5D.69 shows the projected population and demand, the current supplies, and the water management strategies for Highland Park.

Table 5D.69
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Highland Park

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**9,025**	**9,313**	**9,313**	**9,313**	**9,313**	**9,313**
Projected Water Demand						
Municipal Demand	4,056	4,141	4,106	4,091	4,088	4,088
Total Projected Demand	***4,056***	***4,141***	***4,106***	***4,091***	***4,088***	***4,088***
Currently Available Water Supplies						
Dallas County Park Cities Municipal Utility District (Lake Grapevine)	4,022	4,093	4,065	4,036	4,020	4,006
Total Current Supplies	***4,022***	***4,093***	***4,065***	***4,036***	***4,020***	***4,006***
Need (Demand - Current Supply)	***34***	***48***	***41***	***55***	***68***	***82***
Water Management Strategies						
Water Conservation	34	48	41	55	68	82
Total Water Management Strategies	***34***	***48***	***41***	***55***	***68***	***82***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Hutchins

Hutchins is located in southern Dallas County and has a population of about 5,400. The city receives its water supply from DWU. The city currently delivers water to Wilmer, but Wilmer will eventually (by 2040) construct their own direct connection to Dallas supply after which time the connection to Wilmer will be only used for emergency. (Wilmer also plans to begin receiving some of their Dallas supply through Lancaster beginning in 2020, but will continue getting some of their supply through Hutchins until the direct Dallas connection is complete in 2040.) Water management strategies for Hutchins are conservation and additional water from DWU. Table 5D.70 shows the projected population and demand, the current supplies, and the water management strategies for Hutchins.

Table 5D.70
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Hutchins

(Values in Ac-Ft/Yr)	**Projected Population and Demand**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**9,903**	**13,922**	**17,941**	**21,960**	**25,979**	**30,000**
Projected Water Demand						
Municipal Demand	1,022	1,396	1,779	2,166	2,558	2,952
Wholesale Customers (Wilmer)	193	190				
Total Projected Demand	***1,215***	***1,586***	***1,779***	***2,166***	***2,558***	***2,952***
Currently Available Water Supplies						
Dallas Water Utilities	974	1,211	1,378	1,546	1,708	1,878
DWU for Customer (Wilmer)	193	190				
Total Current Supplies	***1,167***	***1,401***	***1,378***	***1,546***	***1,708***	***1,878***
Need (Demand - Current Supply)	***48***	***185***	***401***	***620***	***850***	***1,074***
Water Management Strategies						
Water Conservation	9	14	18	29	43	59
Additional Water from DWU	39	171	383	591	807	1,015
Total Water Management Strategies	***48***	***185***	***401***	***620***	***850***	***1,074***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Irving

Irving is a city of about 227,000 people located in northwestern Dallas County. The city provides water for in-city municipal demand and for Dallas County Manufacturing use in the city. Irving gets its water supply from Chapman Lake and DWU. Recommended water management strategies for Irving are conservation, additional water from DWU, additional Chapman Lake yield due to removal of the silt barrier, and a new reuse project utilizing return flows from TRA's Central Regional Wastewater Plant. Alternative water management strategies for Irving include the Sulphur Basin Supplies Strategy, Marvin Nichols reservoir, indirect reuse (participation in Dallas' Ellis County Off-Channel Reservoir), and Oklahoma (Lake Hugo). Table 5D.71 shows the projected population and demand, the current supplies, and the water management strategies for Irving.

Table 5D.71
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Irving

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**260,752**	**284,500**	**284,500**	**284,500**	**284,500**	**284,500**
Projected Water Demand						
Municipal Demand	56,135	60,148	59,460	59,081	59,001	58,992
Manufacturing Demand	3,779	4,115	4,421	4,670	4,698	4,727
Total Projected Demand	***59,914***	***64,263***	***63,881***	***63,751***	***63,699***	***63,719***
Currently Available Water Supplies						
Chapman Lake for Municipal	35,084	34,568	34,083	33,655	33,447	33,239
Chapman Lake for Manufacturing	3,779	4,115	4,421	4,670	4,698	4,727
Dallas Water Utilities	4,768	4,336	3,872	3,570	3,339	3,180
Total Current Supplies	***43,631***	***43,019***	***42,376***	***41,895***	***41,484***	***41,146***
Need (Demand - Current Supply)	***16,283***	***21,244***	***21,505***	***21,856***	***22,215***	***22,573***
Water Management Strategies						
Water Conservation	1,029	1,584	1,784	1,969	2,163	2,360
Water Conservation (Manufacturing)	0	8	92	132	137	138
Lake Chapman Silt Barrier Removal	3,418	3,326	3,235	3,143	3,052	2,960
Additional Water from DWU	232	664	1,128	1,430	1,661	1,820
TRA Central Reuse Project	28,025	28,025	28,025	28,025	28,025	28,025
Total Water Management Strategies	***32,704***	***33,607***	***34,263***	***34,699***	***35,037***	***35,303***
Reserve (Shortage)	**16,420**	**12,363**	**12,758**	**12,842**	**12,823**	**12,730**

Lancaster

Lancaster is in southern Dallas County and has a population of about 37,000. The city receives most of its water supply from DWU, with a small number of connections in the city being served by Rockett SUD (with water from TRWD). The City of Wilmer is currently designing a connection to Lancaster's delivery system from Dallas, so some amount of Wilmer's Dallas supply will be delivered through Lancaster beginning in 2020. Water management strategies for Lancaster are conservation, a small amount of additional water from Rockett SUD, and additional water from DWU for both Lancaster and Wilmer. Table 5D.72 shows the projected population and demand, the current supplies, and the water management strategies for Lancaster.

Table 5D.72
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Lancaster

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**45,184**	**58,895**	**69,717**	**77,649**	**85,582**	**93,514**
Projected Water Demand						
Municipal Demand	7,686	9,775	11,429	12,659	13,932	15,216
Wilmer (beginning in 2020)	207	242	300	400	600	800
Total Projected Demand	***7,893***	***10,017***	***11,729***	***13,059***	***14,532***	***16,016***
Currently Available Water Supplies						
Dallas Water Utilities	7,243	8,399	8,781	8,974	9,244	9,621
Rockett Special Utility District (TRWD)	62	50	40	34	27	20
Total Current Supplies	***7,305***	***8,449***	***8,821***	***9,008***	***9,271***	***9,641***
Need (Demand - Current Supply)	***588***	***1,568***	***2,908***	***4,051***	***5,261***	***6,375***
Water Management Strategies						
Water Conservation	145	262	358	439	530	630
Additional DWU	208	1,024	2,200	3,156	4,068	4,875
DWU for Wilmer	207	242	300	400	600	800
Additional Water from Rockett SUD	28	40	50	56	63	70
Total Water Management Strategies	***588***	***1,568***	***2,908***	***4,051***	***5,261***	***6,375***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Lewisville

Lewisville is a city of about 98,000 is located in southeastern Denton County with a small area in Dallas County. The water management strategies for Lewisville are described under Denton County in Section 5D.4.

Mesquite

Mesquite is a city of about 142,000 people located in eastern Dallas County extending into western Kaufman County. Mesquite provides water to Dallas County Manufacturing and to Kaufman County Other (specifically Kaufman County MUD #12). The city receives its water supply from NTMWD, and water management strategies for Mesquite are conservation and additional water from NTMWD for the city and its customers. Table 5D.73 shows the projected population and demand, the current supplies, and the water management strategies for Mesquite.

Table 5D.73
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Mesquite

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**150,000**	**165,000**	**186,335**	**203,166**	**219,576**	**236,034**
Projected Water Demand						
Municipal Demand	22,344	23,858	26,361	28,441	30,667	32,947
Dallas County Manufacturing	378	412	442	467	470	473
Kaufman County Other	22	31	169	441	666	1,011
Total Projected Demand	***22,744***	***24,301***	***26,972***	***29,349***	***31,803***	***34,431***
Currently Available Water Supplies						
North Texas Municipal Water District	20,585	18,281	18,618	18,934	19,133	19,028
NTMWD for manufacturing	348	315	312	311	293	273
NTMWD for Kaufman County Other	19	22	102	232	367	521
Total Current Supplies	***20,952***	***18,618***	***19,032***	***19,477***	***19,793***	***19,822***
Need (Demand - Current Supply)	***1,792***	***5,683***	***7,940***	***9,872***	***12,010***	***14,609***
Water Management Strategies						
Water Conservation	186	271	264	379	511	659
Water Conservation (manufacturing)	0	1	9	13	14	14
Add'l NTMWD	1,573	5,306	7,479	9,128	11,023	13,260
Add'l NTMWD for Manufacturing	30	96	121	143	163	186
Add'l NTMWD for Kaufman County Other	3	9	67	209	299	490
Total Water Management Strategies	***1,792***	***5,683***	***7,940***	***9,872***	***12,010***	***14,609***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Ovilla

Ovilla is a city of about 3,500 located in northern Ellis County and southern Dallas County. The water management strategies for Ovilla are described under Ellis County in Section 5D.5.

Richardson

Richardson is a city of about 102,000 people located in northern Dallas County and southern Collin County. The city provides water for in-city municipal demand and for a portion of Collin County Manufacturing use in the city. The city receives its water supply from NTMWD, and water management strategies for Richardson are conservation and additional water from NTMWD. Table 5D.74 shows the projected population and demand, the current supplies, and the water management strategies for Richardson.

Table 5D.74
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Richardson

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**105,000**	**108,200**	**112,500**	**116,000**	**116,000**	**116,000**
Projected Water Demand						
Municipal Demand	26,328	26,676	27,364	28,016	27,979	27,978
Manufacturing Demand (60% of Collin Co)	2,074	2,333	2,591	2,824	3,065	3,328
Total Projected Demand	***28,402***	***29,009***	***29,955***	***30,840***	***31,044***	***31,306***
Currently Available Water Supplies						
North Texas Municipal WD	24,256	20,440	19,326	18,651	17,456	16,158
NTMWD for Collin Co Manufacturing	1,910	1,788	1,830	1,880	1,913	1,922
Total Current Supplies	***26,166***	***22,228***	***21,156***	***20,531***	***19,369***	***18,080***
Need (Demand - Current Supply)	***2,236***	***6,781***	***8,799***	***10,309***	***11,675***	***13,226***
Water Management Strategies						
Water Conservation	604	830	941	1,054	1,146	1,239
Water Conservation (Manufacturing)	0	5	54	80	87	94
Add’l Water from NTMWD	1,468	5,406	7,097	8,311	9,377	10,581
Add'l Water from NTMWD for Manufacturing	164	540	707	864	1,065	1,312
Total Water Management Strategies	***2,236***	***6,781***	***8,799***	***10,309***	***11,675***	***13,226***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rockett Special Utility District

Rockett SUD has a large service area in northern Ellis County extending into Dallas County. Rockett SUD is a wholesale water provider, and there is a discussion of the SUD’s water supply plans in Section 5C.2.

Rowlett

Rowlett is a city of about 56,500 located in northeastern Dallas County and Rockwall County. The city currently receives its water supply from NTMWD, and water management strategies for Rowlett are conservation, additional water from NTMWD, and increase delivery infrastructure from NTWMD. Table 5D.75 shows the projected population and demand, the current supplies, and the water management strategies for Rowlett.

Table 5D.75
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Rowlett

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**64,500**	**70,000**	**70,000**	**70,000**	**70,000**	**70,000**
Projected Water Demand						
Municipal Demand	9,870	10,484	10,348	10,270	10,249	10,248
Total Projected Demand	***9,870***	***10,484***	***10,348***	***10,270***	***10,249***	***10,248***
Currently Available Water Supplies						
North Texas Municipal Water District	9,094	8,034	7,308	6,837	6,395	5,918
Total Current Supplies	***9,094***	***8,034***	***7,308***	***6,837***	***6,395***	***5,918***
Need (Demand - Current Supply)	***776***	***2,450***	***3,040***	***3,433***	***3,854***	***4,330***
Water Management Strategies						
Water Conservation	82	119	103	137	171	205
Additional Water from NTMWD	694	2,331	2,937	3,296	3,683	4,125
Increase delivery infrastructure from NTWMD	*694*	*2,331*	*2,937*	*3,296*	*3,683*	*4,125*
Total Water Management Strategies	***776***	***2,450***	***3,040***	***3,433***	***3,854***	***4,330***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Sachse

Sachse is a city of about 21,500 located in northeastern Dallas County and southern Collin County. Sachse receives its water supply from NTMWD, and water management strategies are conservation and additional water from NTMWD. Table 5D.76 shows the projected population and demand, the current supplies, and the water management strategies for Sachse.

Table 5D.76
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Sachse

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**28,499**	**28,499**	**28,499**	**28,499**	**28,499**	**28,499**
Projected Water Demand						
Municipal Demand	5,179	5,124	5,091	5,071	5,064	5,062
Total Projected Demand	***5,179***	***5,124***	***5,091***	***5,071***	***5,064***	***5,062***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
North Texas Municipal Water District	4,771	3,926	3,596	3,376	3,159	2,923
Total Current Supplies	***4,771***	***3,926***	***3,596***	***3,376***	***3,159***	***2,923***
Need (Demand - Current Supply)	***408***	***1,198***	***1,495***	***1,695***	***1,905***	***2,139***
Water Management Strategies						
Water Conservation	95	137	153	169	186	202
Additional Water from NTMWD	313	1,061	1,342	1,526	1,719	1,937
Total Water Management Strategies	***408***	***1,198***	***1,495***	***1,695***	***1,905***	***2,139***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Seagoville

Seagoville is a city of about 15,000 people located in southeastern Dallas County with some area in Kaufman County. Seagoville is a wholesale water provider, and there is a discussion of the city's water supply plans in Section 5C.2.

Sunnyvale

Sunnyvale located in eastern Dallas County and has a population of about 5,300. The city receives its water supply from NTMWD, and water management strategies are conservation and additional water from NTMWD. Table 5D.77 shows the projected population and demand, the current supplies, and the water management strategies for Sunnyvale.

Table 5D.77
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Sunnyvale

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**7,000**	**10,000**	**13,000**	**15,000**	**18,000**	**18,000**
Projected Water Demand						
Municipal Demand	2,357	3,332	4,313	4,968	5,958	5,957
Total Projected Demand	***2,357***	***3,332***	***4,313***	***4,968***	***5,958***	***5,957***
Currently Available Water Supplies						
North Texas Municipal Water District	2,172	2,553	3,046	3,307	3,717	3,440
Total Current Supplies	***2,172***	***2,553***	***3,046***	***3,307***	***3,717***	***3,440***
Need (Demand - Current Supply)	***185***	***779***	***1,267***	***1,661***	***2,241***	***2,517***
Water Management Strategies						
Water Conservation	43	84	129	166	218	238

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from NTMWD	142	695	1,138	1,495	2,023	2,279
Total Water Management Strategies	***185***	***779***	***1,267***	***1,661***	***2,241***	***2,517***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

University Park

University Park is a city of about 23,000 people in central Dallas County and receives its water supply from the Dallas County Park Cities MUD. The only water management strategy for the city is conservation. Table 5D.78 shows the projected population and demand, the current supplies, and the water management strategy for University Park.

Table 5D.78
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of University Park

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**25,688**	**25,688**	**25,688**	**25,688**	**25,688**	**25,688**
Projected Water Demand						
Municipal Demand	7,622	7,515	7,427	7,379	7,371	7,370
Total Projected Demand	***7,622***	***7,515***	***7,427***	***7,379***	***7,371***	***7,370***
Currently Available Water Supplies						
Dallas County Park Cities MUD	7,558	7,427	7,353	7,281	7,248	7,223
Total Current Supplies	***7,558***	***7,427***	***7,353***	***7,281***	***7,248***	***7,223***
Need (Demand - Current Supply)	***64***	***88***	***74***	***98***	***123***	***147***
Water Management Strategies						
Water Conservation	64	88	74	98	123	147
Total Water Management Strategies	***64***	***88***	***74***	***98***	***123***	***147***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wilmer

Wilmer is a city of about 4,100 people located in southeastern Dallas County. The city receives its water supply from groundwater (Trinity aquifer) and DWU (through Hutchins). In the near future (2020), Wilmer plans to construct an additional take point to get DWU water through Lancaster. By 2040, Wilmer plans to participate in Dallas' construction of a 36" and 24" transmission main from which Wilmer will get the majority of its supply, leaving the connection with Hutchins to be an emergency connection only. Water management strategies for Wilmer are conservation and additional water from DWU (through Hutchins in 2020 and 2030, through Lancaster in 2020 through 2070, and direct from DWU from 2040 through 2070). 5D.79 shows the projected population and demand, the current supplies, and the water management strategies for Wilmer.

Table 5D.79
Projected Population and Demand, Current Supplies
and Water Management Strategies for the City of Wilmer

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,203**	**4,698**	**7,500**	**14,000**	**22,000**	**40,000**
Projected Water Demand						
Municipal Demand	433	466	718	1,323	2,073	3,763
Total Projected Demand	***433***	***466***	***718***	***1,323***	***2,073***	***3,763***
Currently Available Water Supplies						
Trinity Aquifer	29	29	29	29	29	29
Hutchins (DWU)	193	190				
Total Current Supplies	***222***	***219***	***29***	***29***	***29***	***29***
Need (Demand - Current Supply)	***211***	***247***	***689***	***1,294***	***2,044***	***3,734***
Water Management Strategies						
Water Conservation	4	5	7	18	35	75
New connection to DWU (through Lancaster)	207	242	300	400	600	800
New connection to DWU direct			382	876	1,409	2,859
Total Water Management Strategies	***211***	***247***	***689***	***1,294***	***2,044***	***3,734***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wylie

Wylie is city of about 44,300 located in southern Collin County with small areas in Dallas and Rockwall Counties. Wylie's water supply plans are discussed under Collin County in Section 5D.1.

Costs for Dallas County Water User Groups

Table 5D.80 shows the estimated capital costs for Dallas County water management strategies not covered under the wholesale water providers, and Table 5D.81 summarizes the costs by category. Table 5D.82 shows the cost of the alternative strategy not covered under the wholesale water providers, and it is followed by a summary for Dallas County.

Table 5D.80
Costs for Recommended Water Management Strategies for Dallas County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Addison	Conservation	2020	468	$1,086,563	$3.60	$0.45	Q-10
	Additional DWU supplies	2020	3,790	$0	$1.48	$1.48	None
Balch Springs	Conservation	2020	76	$84,625	$0.94	$0.00	Q-10
	Additional DWU supplies	2020	1,310	$0	$1.48	$1.48	None
Carrollton*	Conservation	See Denton County.					
	Additional DWU supplies	See Denton County.					
Cedar Hill*	Conservation	2020	755	$1,474,576	$3.58	$0.70	Q-10
	Additional DWU supplies	2020	5,449	$0	$1.48	$1.48	None
Cockrell Hill	Conservation	2020	23	$26,094	$2.23	$0.00	Q-10
	Additional DWU supplies	2020	392	$0	$1.48	$1.48	None
Combine*	Conservation	See Kaufman County.					
	Additional DWU supplies	See Kaufman County.					
Coppell*	Conservation	2020	443	$1,812,438	$3.63	$0.62	Q-10
	Additional DWU supplies	2020	3,587	$0	$1.48	$1.48	None
Dallas*	Conservation	2020	42,020	$3,124,457	$0.63	$0.37	Q-10
	Other Measures	See DWU in Section 5C.1.					
Dallas County Other	Conservation	2020	13	$48,123	$0.88	$0.00	Q-10
	Additional DWU supplies	2020	418	$0	$1.48	$1.48	None
	Additional Fort Worth supplies	2020	561	$0	$1.96	$1.96	None
DeSoto	Conservation	2020	772	$234,876	$4.47	$1.70	Q-10
	Additional DWU supplies	2020	4,188	$0	$1.48	$1.48	None
Duncanville	Conservation	2020	124	$821,033	$4.13	$0.00	Q-10
	Additional DWU supplies	2020	2,133	$0	$1.48	$1.48	None
East Fork SUD*	Conservation	See Collin County.					
	Additional NTMWD supplies	See Collin County.					
Farmers Branch	Conservation	2020	661	$315,416	$3.36	$1.21	Q-10
	Additional DWU supplies	2020	3,567	$0	$1.48	$1.48	None
Ferris	Conservation	See Ellis County.					
	Additional Rockett SUD supplies	See Ellis County.					

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Garland*	Conservation	2020	741	$2,352,502	$2.10	$0.00	Q-10
	Other Measures	See Garland in Section 5C.2.					
Glenn Heights*	Conservation	2020	123	$72,376	$1.16	$0.00	Q-10
	Additional DWU supplies	2020	1,925	$0	$1.48	$1.48	None
	Increase delivery infrastructure from DWU	*2060*	*1,925*	$2,374,000	$0.42	$0.11	Q-86
Grand Prairie*	Conservation	2020	877	$2,060,148	$2.08	$0.00	Q-10
	Other Measures	See Grand Prairie in Section 5C.2.					
Highland Park	Conservation	2020	82	$87,810	$0.66	$0.00	Q-10
Hutchins	Conservation	2020	59	$129,514	$3.70	$0.00	Q-10
	Additional DWU supplies	2020	1,015	$0	$1.48	$1.48	None
Irving	Conservation	2020	2,360	$7,904,869	$2.87	$0.42	Q-10
	Lake Chapman Silt Barrier Removal	Included under NTMWD in Table 5C.8					
	TRA Central Reuse Project	2020	28,025	$39,960,000	$1.52	$1.16	Q-90
	Lake Chapman Booster Pump Station	2020	0	$8,546,000	NA	NA	Q-24
	Additional DWU supplies	2020	1,820	$0	$1.48	$1.48	None
Lancaster	Conservation	2020	630	$1,050,053	$4.17	$0.87	Q-10
	Additional Rockett SUD supplies	2020	70	$0	$3.75	$3.75	None
	Additional DWU supplies	2020	4,875	$0	$1.48	$1.48	None
Lewisville*	Conservation	See Denton County.					
	New water treatment plant and expansions	See Denton County.					
	Additional DWU supplies	See Denton County.					
Mesquite*	Conservation	2020	659	$3,173,984	$4.38	$0.00	Q-10
	Additional NTMWD supplies	2020	13,260	$0	$1.70	$1.70	None
Ovilla*	Conservation	See Ellis County.					
	Additional DWU supplies	See Ellis County.					
	Increase delivery infrastructure from DWU	See Ellis County.					
Richardson*	Conservation	2020	1,239	$792,858	$1.19	$0.45	Q-10
	Additional NTMWD supplies	2020	10,581	$0	$1.70	$1.70	None

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Rockett SUD*	Conservation	See Ellis County.					
	Other measures	See Rockett SUD in Section 5C.					
Rowlett*	Conservation	2020	205	$1,471,425	$4.61	$0.00	Q-10
	Additional NTMWD supplies	2020	4,125	$0	$1.75	$1.75	None
	Increase delivery infrastructure from NTMWD	*2020*	*4,125*	$3,519,000	$2.08	$1.87	Q-214
Sachse*	Conservation	2020	202	$516,882	$3.59	$1.03	Q-10
	Additional NTMWD supplies	2020	1,937	$0	$1.75	$1.75	None
Seagoville*	Conservation	2020	71	$76,397	$1.15	$0.00	Q-10
	Additional DWU supplies	2020	5,756	$0	$1.48	$1.48	None
Sunnyvale	Conservation	2020	238	$169,489	$2.39	$0.60	Q-10
	Additional DWU supplies	2020	2,279	$0	$1.48	$1.48	None
	Additional pipeline from DWU	*2020*	*2,279*	$22,408,000	$4.34	$1.82	Q-93
University Park	Conservation	2020	147	$4,000,000	$16.05	$0.00	Q-10
Wilmer	Conservation	2020	75	$11,495	$0.74	$0.00	Q-10
	Additional DWU supplies	2020	3,659	$0	$1.48	$1.48	None
	New Connection to Dallas (via Lancaster)	*2020*	*800*	$4,504,300	$1.73	$0.28	Q-95
	Direct Connection to Dallas 36" Transmission Line	*2040*	*2,859*	$15,999,500	$1.62	$0.18	Q-94
Wylie*	Conservation	See Collin County.					
	Additional NTMWD supplies	See Collin County.					
Dallas County Irrigation	Conservation	2020	975	$0	$0.95	$0.95	Q-11
	Los Colinas Expansion	2030	7,000	See TRA in Section 5C.			
Dallas County Livestock	None	None					

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Dallas County Manufacturing	Conservation	2030	1,379	$0	$0.95	$0.95	Q-11
	Additional DWU supplies	2020	12,643	$0	$1.48	$1.48	None
	Additional NTMWD supplies	2020	1,997	$0	$1.75	$1.75	None
	Additional Grand Prairie supplies	2020	627	$0	$2.50	$2.50	None
Dallas County Mining	Additional DWU supplies	2020	90	$0	$0.74	$0.74	None
Dallas County Steam Electric	Additional DWU supplies	2020	1,820	$0	$0.74	$0.74	None
	Reuse (TRA)	2030	2,000	See TRA in Section 5C.			

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.81
Summary of Recommended Water Management Strategies for Dallas County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	55,417	$32,898,003
Purchase from WWP	93,873	$0
Delivery Infrastructure	*11,988*	$57,350,800
Reuse	37,025	$39,960,000
Total		**$130,208,803**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

Table 5D.82
Summary of Alternative Water Management Strategies for Dallas County Not Covered Under Wholesale Water Providers

Type of Strategy	Entity	Quantity (Ac-Ft/Yr)	Capital Costs
Sulphur Basin Supplies	Irving	25,000	$243,287,000
Marvin Nichols Reservoir	Irving	25,000	$210,006,000
Indirect Reuse (Ellis County Off-Channel Reservoir)	Irving	25,000	$30,474,000
Oklahoma (Lake Hugo)	Irving	25,000	$177,686,000
Total			**$661,453,000**

*Cost to be developed prior to final plan.

2010 Population: *2,368,139*

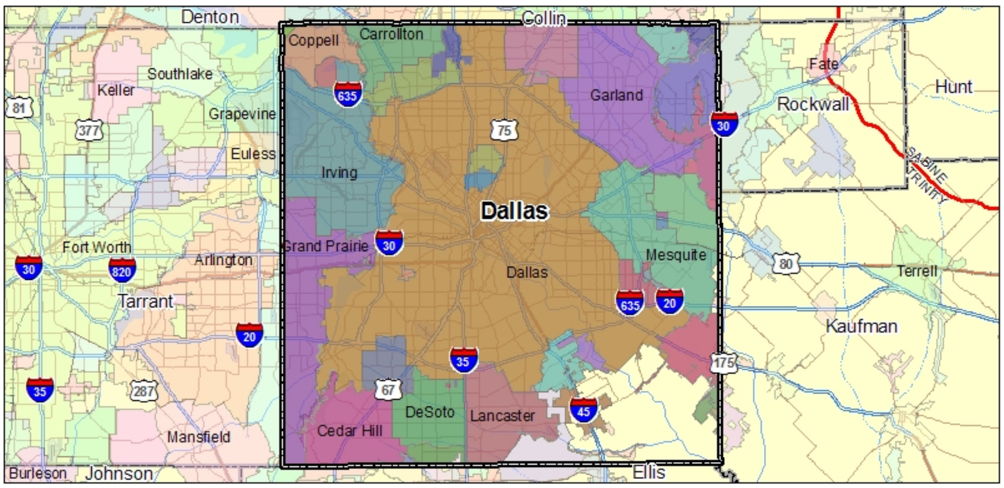
Projected 2070 Population: *3,697,105*

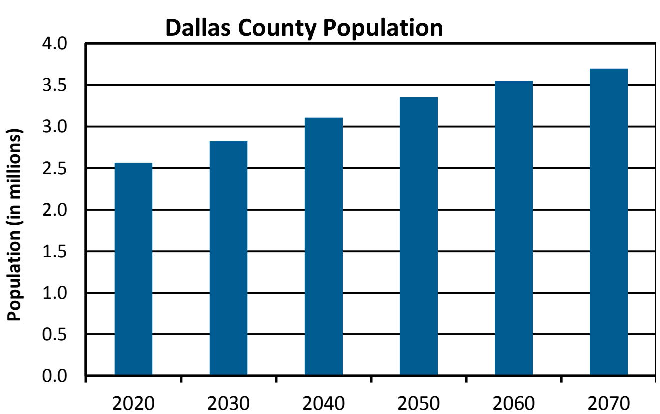
County Seat: *Dallas*

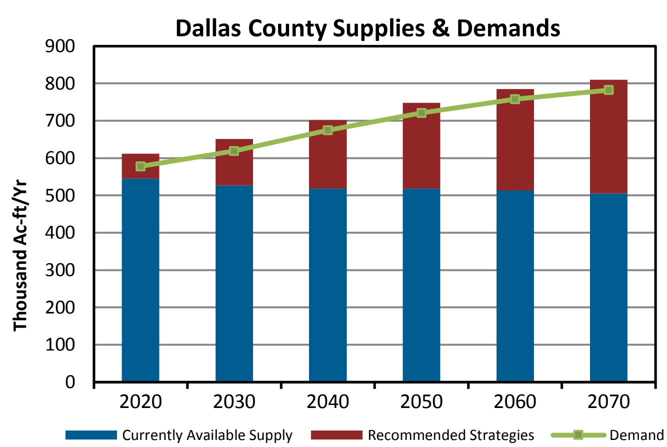
Economy: *Telecommunications, transportation, manufacturing, government/services.*

River Basin(s):

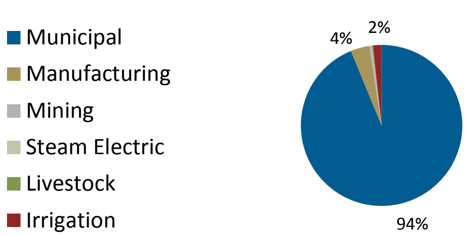
- Trinity (100%)





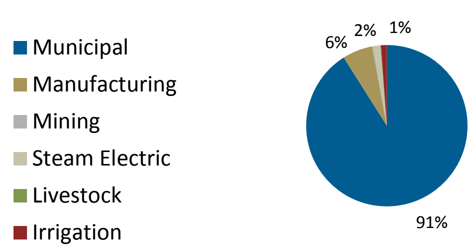


2010 Dallas County Historical Demand
(% of total)



Total=527,846 acre-feet

2070 Dallas County Projected Demand
(% of total)



Total= 782,053 acre-feet

5D.4 Denton County

Figure 5D.4 is a map of Denton County, which has many sources of water supply. Denton County is in the North Texas Groundwater Conservation District. The Upper Trinity Regional Water District (UTRWD), a wholesale water provider in Region C, supplies water to many water user groups in Denton County and is expected supply an increasing amount of water in the county. The City of Denton has its own supplies and plans to obtain raw water from Dallas Water Utilities (DWU) in the future. Other wholesale water providers also supply treated water to Denton County:

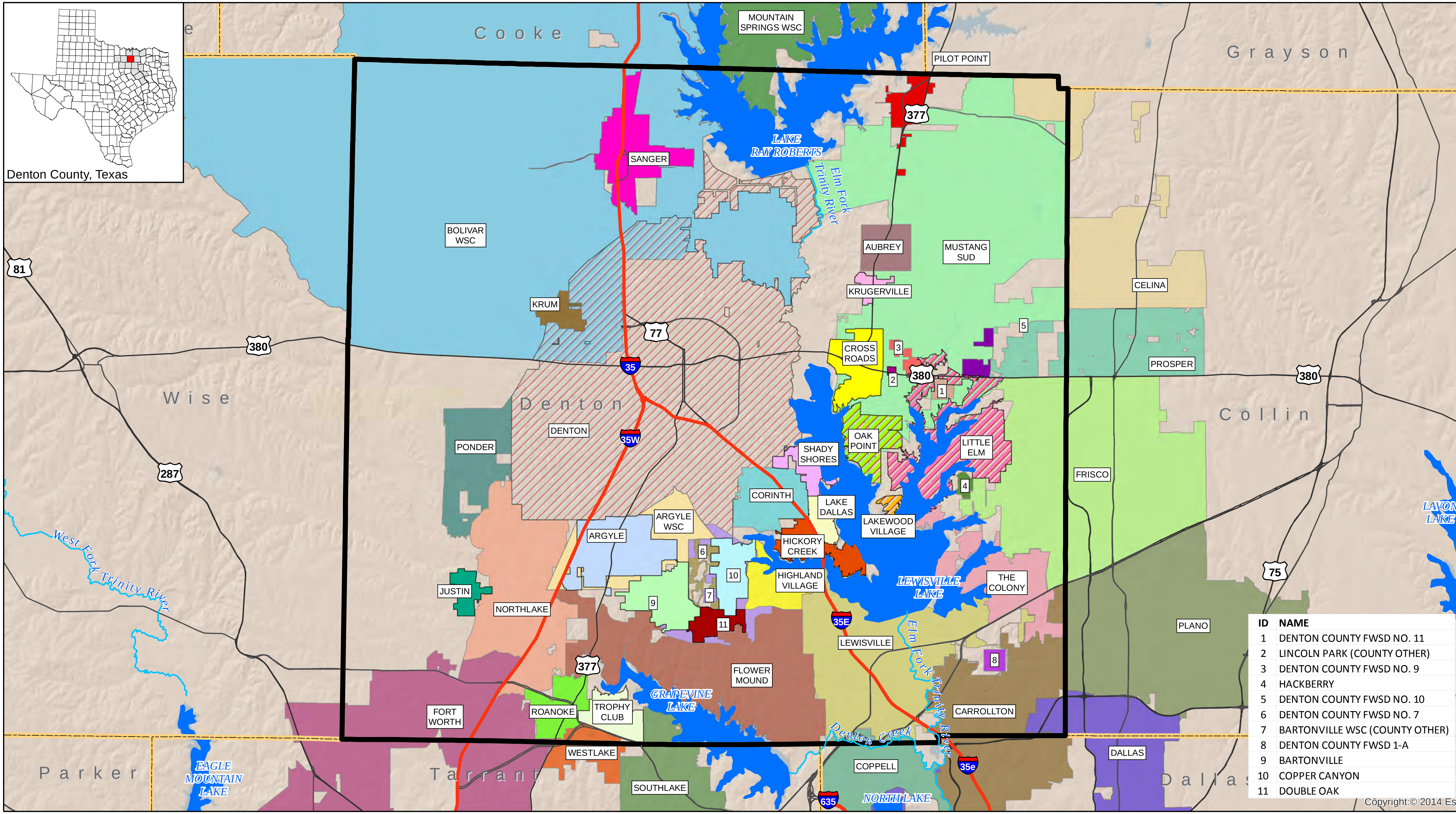
- Dallas Water Utilities (DWU) supplies cities in the southeast part of the county (Carrollton, Coppell, Dallas, Lewisville, and The Colony).
- North Texas Municipal Water District (NTMWD) provides water to cities in the east part of the county (Frisco, Hackberry, Little Elm, and Prosper).
- Fort Worth supplies cities in the south and southwest part of the county (Northlake, Roanoke, Southlake, and Trophy Club).

Many water suppliers in Denton County have traditionally used groundwater, but the growing demand for water has caused suppliers to increase their use of surface water supplies in recent years. Surface water use is expected to continue to grow in the future.

Water management strategies for Denton County water user groups are discussed below (in alphabetical order). Table 5D.123 shows the estimated capital costs for the Denton County water management strategies not associated with the wholesale water providers, and Table 5D.124 is a summary of the costs by category. Table 5D.124 is followed by a summary for Denton County.

Argyle

Argyle is a city of about 3,500 people located in southern Denton County. Argyle WSC provides retail water service within the city, and Argyle WSC's water supply is from groundwater and UTRWD. Water management strategies for Argyle are conservation and additional water from Argyle WSC (from UTRWD). Table 5D.83 shows the projected population and demand, the current supplies, and the water management strategies for Argyle.



FREESE AND NICHOLS

Project No: NTD11336

County Boundary
Denton County Boundary
River Basin Divide
River
Reservoir

N S E W

1 inch = 4 miles

0 2 4 8

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Denton County, Texas

Figure 5D.4

Table 5D.83
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Argyle

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,000**	**9,000**	**13,000**	**13,000**	**13,000**	**13,000**
Projected Water Demand						
Municipal Demand	1,395	2,064	2,966	2,961	2,960	2,959
Total Projected Water Demand	***1,395***	***2,064***	***2,966***	***2,961***	***2,960***	***2,959***
Currently Available Water Supplies						
Argyle WSC (groundwater)	450	450	450	450	450	450
Argyle WSC (UTRWD)	909	1,184	1,471	1,201	1,097	962
Total Current Supplies	***1,359***	***1,634***	***1,921***	***1,651***	***1,547***	***1,412***
Need (Demand - Current Supply)	***36***	***430***	***1,045***	***1,310***	***1,413***	***1,547***
Water Management Strategies						
Water Conservation	36	100	158	168	178	187
Additional Water from Argyle WSC (UTRWD)	0	375	977	1,279	1,416	1,541
Total Water Management Strategies	***36***	***475***	***1,135***	***1,447***	***1,594***	***1,728***
Reserve (Shortage)	**0**	**45**	**90**	**137**	**181**	**181**

Argyle Water Supply Corporation

Argyle WSC serves about 2,000 people in and around the City of Argyle in Denton County. Argyle WSC is a wholesale water provider, and there is a discussion of the WSC's water supply plans in Section 5C.2.

Aubrey

Aubrey is a city of about 2,700 people in northeast Denton County. A significant amount of rural population (Denton County Other WUG) lies within Aubrey's ETJ (Extra Territorial Jurisdiction), and Aubrey plans to supply water to this area. The city receives its water supply from UTRWD. Water management strategies for Aubrey are conservation and additional water from UTRWD. Any infrastructure needed to treat and deliver water from UTRWD to Aubrey is the responsibility of UTRWD and is included in UTRWD's strategies in this plan. Table 5D.84 shows the projected population and demand, the current supplies, and the water management strategies for Aubrey.

Table 5D.84
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Aubrey

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population-Aubrey	4,726	6,284	7,349	8,713	10,459	12,693
Projected Population-Denton Co Other	1,030	12,400	21,474	35,190	40,990	42,441
Total Projected Population	**5,756**	**18,684**	**28,823**	**43,903**	**51,449**	**55,134**
Projected Water Demand						
Municipal Demand-Aubrey	563	731	847	999	1,197	1,452
Municipal Demand-Denton Co Other	129	1,528	2,646	4,297	4,959	5,134
Total Projected Demand	***692***	***2,259***	***3,493***	***5,296***	***6,156***	***6,586***
Currently Available Water Supplies						
UTRWD	563	575	520	486	519	552
UTRWD for Denton Co Other	129	968	1,231	2,055	2,150	1,951
Total Current Supplies	***692***	***1,543***	***1,751***	***2,541***	***2,669***	***2,503***
Need (Demand - Current Supply)	***0***	***716***	***1,742***	***2,755***	***3,487***	***4,083***
Water Management Strategies						
Water Conservation	5	8	8	13	20	29
Add'l Water from UTRWD-Aubrey	0	148	319	500	658	871
Add'l Water from UTRWD-Denton Co Other	0	560	1,415	2,242	2,809	3,183
Total Water Management Strategies	***5***	***716***	***1,742***	***2,755***	***3,487***	***4,083***
Reserve (Shortage)	**5**	**0**	**0**	**0**	**0**	**0**

Bartonville

Bartonville is a city of about 1,600 people in southern Denton County. Cross Timbers WSC provides retail water service to the residents of Bartonville, and Cross Timber WSC's water supply comes from groundwater and UTRWD. Water management strategies for Bartonville are conservation and additional water from Cross Timbers WSC. Table 5D.85 shows the projected population and demand, the current supplies, and the water management strategies for Bartonville.

Table 5D.85
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Bartonville

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,500**	**5,000**	**5,000**	**5,000**	**5,000**	**5,000**
Projected Water Demand						
Municipal Demand	825	907	903	900	900	899
Total Projected Water Demand	***825***	***907***	***903***	***900***	***900***	***899***
Currently Available Water Supplies						
Cross Timbers WSC (Groundwater)	168	168	168	168	168	168
Cross Timbers WSC (UTRWD)	656	595	473	382	346	303
Total Current Supplies	***824***	***763***	***641***	***550***	***514***	***471***
Need (Demand - Current Supply)	***1***	***144***	***262***	***350***	***386***	***428***
Water Management Strategies						
Water Conservation	15	24	27	30	33	36
Add'l Water from Cross Timbers WSC (UTRWD)	0	137	269	371	420	459
Total Water Management Strategies	***15***	***161***	***296***	***401***	***453***	***495***
Reserve (Shortage)	**14**	**17**	**34**	**51**	**67**	**67**

Bolivar Water Supply Corporation

Bolivar WSC serves retail customers in northeastern Wise County and in Denton and Cooke Counties. In previous Region C Plans, Bolivar WSC was considered a Wholesale Water Provider (WWP), but Bolivar WSC no longer sells to any other water user groups, and is no longer considered a WWP. Bolivar WSC serves about 10,500 people and currently gets its water from the Trinity Aquifer. Water management strategies for Bolivar WSC include conservation, connecting to and purchasing water from Upper Trinity Regional Water District, and connecting to and purchasing water from Gainesville. Table 5D.86 shows the projected population and demand, the current supplies, and the water management strategies for Bolivar WSC.

Table 5D.86
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Bolivar Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**12,343**	**14,705**	**17,444**	**20,491**	**24,004**	**27,974**
Projected Water Demand						
Municipal Demand	1,105	1,257	1,447	1,678	1,957	2,277
Total Projected Demand	***1,105***	***1,257***	***1,447***	***1,678***	***1,957***	***2,277***
Currently Available Water Supplies						
Trinity Aquifer	1,114	1,114	1,114	1,114	1,114	1,114
Total Current Supplies	***1,114***	***1,114***	***1,114***	***1,114***	***1,114***	***1,114***
Need (Demand - Current Supply)	***0***	***143***	***333***	***564***	***843***	***1,163***
Water Management Strategies						
Water Conservation	9	14	14	22	33	46
Connect to UTRWD	0	190	467	776	1,131	1,413
Connect to Gainesville	0	50	75	100	125	150
Total Water Management Strategies	***9***	***254***	***556***	***898***	***1,289***	***1,609***
Reserve (Shortage)	**18**	**111**	**223**	**334**	**446**	**446**

Carrollton

Carrollton is a city of about 124,000 people located in southern Denton County and northwest Dallas County. The City of Carrollton receives its water supply from groundwater (very small amount from the Trinity aquifer) and DWU. Water management strategies for Carrollton are conservation and additional water from DWU. Table 5D.87 shows the projected population and demand, the current supplies, and the water management strategies for Carrollton.

Table 5D.87
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Carrollton

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**126,763**	**129,176**	**129,179**	**129,182**	**129,185**	**129,188**
Projected Water Demand						
Municipal Demand	23,566	23,504	23,112	22,895	22,852	22,850
Total Projected Demand	***23,566***	***23,504***	***23,112***	***22,895***	***22,852***	***22,850***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Trinity Aquifer						
Dallas Water Utilities	22,470	20,382	17,898	16,346	15,261	14,534
Total Current Supplies	***22,503***	***20,415***	***17,931***	***16,379***	***15,294***	***14,567***
Need (Demand - Current Supply)	***1,063***	***3,089***	***5,181***	***6,516***	***7,558***	***8,283***
Water Management Strategies						
Water Conservation	432	627	693	763	838	914
Additional Water from DWU	631	2,462	4,488	5,753	6,720	7,369
Total Water Management Strategies	***1,063***	***3,089***	***5,181***	***6,516***	***7,558***	***8,283***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Celina

The City of Celina has a population of about 6,700 people and is located in northwest Collin County. Celina is projected to grow rapidly in the coming decades and to expand into Denton County. Water supply plans for Celina are discussed under Collin County in Section 5D.1.

Coppell

Coppell has a population of about 39,000 people and is located in northwest Dallas County with a small population in Denton County. Water supply plans for Coppell are discussed under Dallas County in Section 5D.3.

Copper Canyon

Copper Canyon is a city of about 1,350 people in southern Denton County. Cross Timbers WSC provides retail water service to the residents of Copper Canyon, and Cross Timbers WSC's water supply comes from groundwater (Trinity aquifer) and UTRWD. Water management strategies for Copper Canyon are conservation and additional water from Cross Timbers WSC. Table 5D.88 shows the projected population and demand, the current supplies, and the water management strategies for Copper Canyon.

Table 5D.88
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Copper Canyon

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,419**	**1,523**	**1,647**	**1,785**	**1,947**	**2,131**
Projected Water Demand						
Municipal Demand	260	272	289	310	338	369

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Projected Water Demand	***260***	***272***	***289***	***310***	***338***	***369***
Currently Available Water Supplies						
Cross Timbers WSC (Groundwater)	167	167	167	167	167	167
Cross Timbers WSC (UTRWD)	93	94	96	94	103	101
Total Current Supplies	***260***	***261***	***263***	***261***	***270***	***268***
Need (Demand - Current Supply)	***0***	***11***	***26***	***49***	***68***	***101***
Water Management Strategies						
Water Conservation	5	7	9	10	12	15
Add'l Water from Cross Timbers WSC (UTRWD)	0	21	50	89	122	152
Total Water Management Strategies	***5***	***28***	***59***	***99***	***134***	***167***
Reserve (Shortage)	**5**	**17**	**33**	**50**	**66**	**66**

Corinth

Corinth is a city of about 20,500 people located in central Denton County. The city gets its water supply from groundwater (Trinity aquifer) and UTRWD. Water management strategies for Corinth are conservation, increasing the current well pumping capacity by 0.5 MGD, adding two new 1.0 MGD wells, and additional water from UTRWD. Table 5D.89 shows the projected population and demand, the current supplies, and the water management strategies for Corinth.

Table 5D.89
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Corinth

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**24,911**	**29,499**	**29,499**	**29,499**	**29,499**	**29,499**
Projected Water Demand						
Municipal Demand	4,266	4,983	4,956	4,939	4,932	4,931
Total Projected Demand	***4,266***	***4,983***	***4,956***	***4,939***	***4,932***	***4,931***
Currently Available Water Supplies						
Trinity Aquifer	274	274	274	274	274	274
Upper Trinity Regional Water District	3,145	2,598	2,010	1,586	1,409	1,234
Total Current Supplies	***3,419***	***2,872***	***2,284***	***1,860***	***1,683***	***1,509***
Need (Demand - Current Supply)	***847***	***2,111***	***2,672***	***3,079***	***3,249***	***3,422***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	84	143	162	178	194	210
New Wells in Trinity Aquifer	847	1,408	1,408	1,408	1,408	1,408
Additional Water from UTRWD	0	560	1,102	1,493	1,647	1,804
Total Water Management Strategies	***931***	***2,111***	***2,672***	***3,079***	***3,249***	***3,422***
Reserve (Shortage)	**84**	**0**	**0**	**0**	**0**	**0**

Cross Roads

Cross Roads is a city of about 1,700 in central Denton County. The residents of Cross Roads are provided retail water service by Mustang SUD, and the water supply comes from UTRWD. Water management strategies for Cross Roads are conservation and additional water from Mustang SUD (from UTRWD). Table 5D.90 shows the projected population and demand, the current supplies, and the water management strategies for Cross Roads.

Table 5D.90
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Cross Roads

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,256**	**3,096**	**3,800**	**3,800**	**3,800**	**3,800**
Projected Water Demand						
Municipal Demand	457	619	756	755	754	754
Total Projected Demand	***457***	***619***	***756***	***755***	***754***	***754***
Currently Available Water Supplies						
Mustang SUD (UTRWD)	456	487	463	368	327	287
Total Current Supplies	***456***	***487***	***463***	***368***	***327***	***287***
Need (Demand - Current Supply)	***1***	***132***	***293***	***387***	***427***	***467***
Water Management Strategies						
Water Conservation	8	16	23	25	28	30
Add'l from Mustang SUD (UTRWD)	0	116	270	362	399	437
Total Water Management Strategies	***8***	***132***	***293***	***387***	***427***	***467***
Reserve (Shortage)	**7**	**0**	**0**	**0**	**0**	**0**

Dallas

Dallas Water Utilities (DWU) is the water utility of the City of Dallas, which has a population of about 1,230,000. DWU is a wholesale water provider. The City of Dallas is primarily in Dallas County but extends into Denton County (and other counties). There is a detailed discussion of water supply plans for DWU beginning in Section 5C.1.

Denton

Denton is a city of about 121,000 in central Denton County and is a wholesale water provider. Denton's water supply plans are discussed in Section 5C.2.

Denton County Fresh Water Supply District No. 1A

Denton County FWSD No. 1A serves about 8,900 people in southeastern Denton County. The District currently receives most of its water supply from UTRWD and a smaller portion from Lewisville (which in turn gets water from DWU). Water management strategies for Denton County FWSD No. 1A are conservation, additional water from UTRWD, and additional water from Lewisville. Table 5D.91 shows the projected population and demand, the current supplies, and the water management strategies for Denton County FWSD No. 1A.

Table 5D.91
Projected Population and Demand, Current Supplies, and Water Management Strategies for Denton County FWSD No. 1A

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**14,000**	**25,021**	**30,000**	**30,000**	**30,000**	**30,000**
Projected Water Demand						
Municipal Demand	3,659	6,494	7,777	7,774	7,771	7,769
Total Projected Demand	***3,659***	***6,494***	***7,777***	***7,774***	***7,771***	***7,769***
Currently Available Water Supplies						
Upper Trinity Regional Water District	2,452	3,425	3,199	2,536	2,257	1,978
Lewisville (DWU)	1,151	1,857	1,959	1,748	1,581	1,581
Total Current Supplies	***3,603***	***5,282***	***5,158***	***4,284***	***3,838***	***3,559***
Need (Demand - Current Supply)	***56***	***1,212***	***2,619***	***3,490***	***3,933***	***4,210***
Water Management Strategies						
Conservation	67	159	233	259	285	311
Additional Water from UTRWD	0	820	1,855	2,499	2,758	3,019

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from Lewisville (DWU)	34	234	531	732	889	880
Total Water Management Strategies	***101***	***1,212***	***2,619***	***3,490***	***3,933***	***4,210***
Reserve (Shortage)	**45**	**0**	**0**	**0**	**0**	**0**

Denton County Fresh Water Supply District No. 7

Denton County FWSD No. 7 serves 6,700 people in south-central Denton County. The District currently receives all of its water supply from UTRWD. Water management strategies for Denton County FWSD No. 7 are conservation and additional water from UTRWD. Table 5D.92 shows the projected population and demand, the current supplies, and the water management strategies for Denton County FWSD No. 7.

Table 5D.92
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Denton County FWSD No. 7

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**13,500**	**13,500**	**13,500**	**13,500**	**13,500**	**13,500**
Projected Water Demand						
Municipal Demand	3,418	3,405	3,403	3,401	3,399	3,397
Total Projected Demand	***3,418***	***3,405***	***3,403***	***3,401***	***3,399***	***3,397***
Currently Available Water Supplies						
Upper Trinity Regional Water District	3,418	2,680	2,089	1,656	1,474	1,291
Total Current Supplies	***3,418***	***2,680***	***2,089***	***1,656***	***1,474***	***1,291***
Need (Demand - Current Supply)	***0***	***725***	***1,314***	***1,745***	***1,925***	***2,106***
Water Management Strategies						
Conservation	66	98	110	121	132	143
Additional Water from UTRWD	0	627	1,204	1,624	1,793	1,963
Total Water Management Strategies	***66***	***725***	***1,314***	***1,745***	***1,925***	***2,106***
Reserve (Shortage)	**66**	**0**	**0**	**0**	**0**	**0**

Denton County Fresh Water Supply District No. 10

Denton County FWSD No. 10 serves about 4,100 people in eastern Denton County. The District currently receives some of its water supply from Upper Trinity Regional Water District, with a portion of that supply being provided through Mustang SUD, which acts as a contract operator for a portion of the District's water system. Water management strategies for Denton County FWSD No. 10 are conservation, additional water from UTRWD through the portion of the water system operated by Mustang SUD, and additional water from Upper Trinity Regional Water District. Table 5D.93 shows the projected population and demand, the current supplies, and the water management strategies for Denton County FWSD No. 10.

Table 5D.93
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Denton County FWSD No. 10

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**7,884**	**16,750**	**16,750**	**16,750**	**16,750**	**16,750**
Projected Water Demand						
Municipal Demand	1,486	3,128	3,127	3,126	3,124	3,124
Total Projected Demand	***1,486***	***3,128***	***3,127***	***3,126***	***3,124***	***3,124***
Currently Available Water Supplies						
Mustang SUD (UTRWD)	298	1,539	1,201	952	848	742
Upper Trinity Regional Water District	1,188	923	719	570	506	444
Total Current Supplies	***1,486***	***2,462***	***1,920***	***1,522***	***1,354***	***1,186***
Need (Demand - Current Supply)	***0***	***666***	***1,207***	***1,604***	***1,770***	***1,938***
Water Management Strategies						
Conservation	29	82	100	111	121	132
Additional Mustang SUD (UTRWD)	0	366	692	935	1,032	1,131
Additional Water from UTRWD	0	219	415	559	616	675
Total Water Management Strategies	***29***	***666***	***1,207***	***1,604***	***1,770***	***1,938***
Reserve (Shortage)	**29**	**0**	**0**	**0**	**0**	**0**

Denton County Irrigation

Table 5D.94 shows the projected demand, the current supplies, and the water management strategies for Denton County Irrigation. Golf course irrigation is the largest part of the irrigation water use in Denton County. (The Texas Water Development classifies the use of potable water for golf course irrigation as a part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.) As shown in Table 5D.94, direct reuse from several sources, DWU, groundwater (Woodbine and Trinity aquifers) all provide water for irrigation in Denton County. Water management strategies include water conservation and additional direct reuse water from UTRWD.

Table 5D.94
Projected Demand, Current Supplies,
and Water Management Strategies for Denton County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**2,137**	**2,137**	**2,137**	**2,137**	**2,137**	**2,137**
Currently Available Water Supplies						
Direct Reuse (UTRWD)	897	897	897	897	897	897
Direct Reuse (Denton)	406	406	406	406	406	406
Direct Reuse (Trophy Club MUD #1)	800	800	800	800	800	800
Dallas Water Utilities	429	390	348	321	301	286
Trinity Aquifer	400	400	400	400	400	400
Woodbine Aquifer	1,000	1,000	1,000	1,000	1,000	1,000
Total Current Supplies	***3,932***	***3,893***	***3,851***	***3,824***	***3,804***	***3,789***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	37	72	90	107	124
Additional UTRWD Direct Reuse	0	560	1,121	2,240	2,240	2,240
Total Water Management Strategies	***2***	***597***	***1,193***	***2,330***	***2,347***	***2,364***
Reserve (Shortage)	**1,797**	**2,353**	**2,907**	**4,017**	**4,014**	**4,016**

Denton County Livestock

Table 5D.95 shows the projected demand, current supplies, and water management strategies for Denton County Livestock. The current supplies for Denton County Livestock are local surface water supplies and groundwater (Trinity and Woodbine aquifers). The sources are sufficient to meet future demands, and there are no water management strategies.

Table 5D.95
Projected Demand, Current Supplies,
and Water Management Strategies for Denton County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,045**	**1,045**	**1,045**	**1,045**	**1,045**	**1,045**
Currently Available Water Supplies						
Local Supplies	622	622	622	622	622	622
Trinity Aquifer	240	240	240	240	240	240
Woodbine Aquifer	490	490	490	490	490	490
Total Current Supplies	***1,352***	***1,352***	***1,352***	***1,352***	***1,352***	***1,352***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**307**	**307**	**307**	**307**	**307**	**307**

Denton County Manufacturing

Table 5D.96 shows the projected demand, the current supplies, and the water management strategies for Denton County Manufacturing. Current supplies include UTRWD, Denton, DWU, NTMWD, Northlake (TRWD), and groundwater (Trinity aquifer). Conservation and additional supplies from all the current sources, as well as new wells in the Woodbine Aquifer, are the water management strategies to meet demands.

Table 5D.96
Projected Demand, Current Supplies,
and Water Management Strategies for Denton County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,446**	**1,643**	**1,843**	**2,020**	**2,194**	**2,383**
Currently Available Water Supplies						
Upper Trinity Regional Water District	72	129	113	98	95	90
Denton (Lake Ray Roberts)	759	670	601	524	419	375
Denton (Lake Lewisville)	314	276	247	214	170	152
Dallas Water Utilities	96	100	100	101	103	106
Trinity Aquifer	11	11	11	11	11	11
North Texas Municipal Water District	66	63	65	67	69	69
Northlake (TRWD sources)	14	15	14	14	14	14
Total Current Supplies	***1,332***	***1,263***	***1,151***	***1,030***	***880***	***816***
Need (Demand - Current Supply)	***114***	***380***	***692***	***990***	***1,314***	***1,567***
Water Management Strategies						
Water Conservation	0	3	38	57	62	68
Additional Water from UTRWD	0	35	67	98	118	141
Additional Water from DWU	5	15	26	36	47	56
Additional Water from NTMWD	6	19	25	31	38	47
Additional Water from Denton	128	416	650	892	1,181	1,396

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from Northlake	0	1	4	5	7	9
New Wells in Woodbine Aquifer	184	184	184	184	184	184
Total Water Management Strategies	***322***	***674***	***994***	***1,302***	***1,638***	***1,901***
Reserve (Shortage)	**208**	**294**	**302**	**312**	**324**	**334**

Denton County Mining

Table 5D.97 shows the projected demand, the current supplies, and the water management strategies for Denton County Mining. Denton County Mining is supplied from UTRWD and groundwater (Trinity aquifer). The water management strategies for this water user group are additional supplies from UTRWD. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5D.97
Projected Demand, Current Supplies,
and Water Management Strategies for Denton County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**4,326**	**2,729**	**3,345**	**4,306**	**5,204**	**6,291**
Currently Available Water Supplies						
Upper Trinity Regional Water District (through multiple suppliers)	2,363	603	848	1,141	1,405	1,645
Trinity Aquifer	1,963	1,963	1,963	1,963	1,963	1,963
Total Current Supplies	***4,326***	***2,566***	***2,811***	***3,104***	***3,368***	***3,608***
Need (Demand - Current Supply)	***0***	***163***	***534***	***1,202***	***1,836***	***2,683***
Water Management Strategies						
Additional Water from UTRWD	0	163	534	1,202	1,836	2,683
Total Water Management Strategies	***0***	***163***	***534***	***1,202***	***1,836***	***2,683***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Denton County Other

Denton County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Denton County Other include individual properties as well as numerous Denton County Fresh Water Supply Districts not named as individual WUGs. The entities included under Denton County Other currently receive their water supply from Little

Elm (NTMWD supplies), UTRWD (through various suppliers), and groundwater (Trinity and Woodbine aquifers). Although groundwater is shown to be available in this plan, there is increasing uncertainty associated with use of groundwater and it is anticipated that many Denton County Other entities will decrease groundwater use in the future, opting for more surface supplies. Water management strategies for these entities include conservation, additional supplies from Little Elm and UTRWD, and new wells in the Trinity and Woodbine aquifers. Table 5D.98 shows the projected population and demand, the current supplies, and the water management strategies for Denton County Other.

Table 5D.98
Projected Population and Demand, Current Supplies, and Water Management Strategies for Denton County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**30,207**	**33,609**	**37,232**	**53,174**	**86,087**	**160,675**
Projected Water Demand						
Municipal Demand	3,785	4,155	4,574	6,487	10,458	19,480
Total Projected Water Demand	***3,785***	***4,155***	***4,574***	***6,487***	***10,458***	***19,480***
Currently Available Water Supplies						
Little Elm (NTWMD	1,658	1,379	1,271	1,198	1,123	1,040
UTRWD (Direct and thru Aubrey)	595	968	1,231	2,055	3,650	6,701
UTRWD (Cross Timbers WSC)	36	56	67	72	78	80
Trinity Aquifer	1,640	1,640	1,640	1,640	1,640	1,640
Woodbine Aquifer	1,165	1,165	1,165	1,165	1,165	1,165
Total Current Supplies	***5,094***	***5,208***	***5,375***	***6,130***	***7,656***	***10,626***
Need (Demand - Current Supply)	***0***	***0***	***0***	***357***	***2,802***	***8,854***
Water Management Strategies						
Water Conservation	32	47	46	86	174	390
Additional Water from Little Elm	134	409	521	593	668	749
Add'l Water from UTRWD (Direct and thru Aubrey)	0	243	751	2,106	4,628	10,584
Add'l Water from UTRWD (thru Cross Timbers WSC)	0	208	452	673	814	923
New wells in Trinity Aquifer	504	504	504	504	504	504
New wells in Woodbine Aquifer	817	817	817	817	817	817
Total Water Management Strategies	***1,487***	***2,228***	***3,091***	***4,778***	***7,605***	***13,967***
Reserve (Shortage)	**2,796**	**3,281**	**3,891**	**4,421**	**4,803**	**5,113**

Denton County Steam Electric Power

Table 5D.99 shows the projected demand, the current supplies, and the water management strategies for Denton County Steam Electric Power. Denton County Steam Electric Power is currently supplied by direct reuse from Denton. There are no water management strategy for this water user group.

Table 5D.99
Projected Demand, Current Supplies,
and Water Management Strategies for Denton County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**646**	**733**	**819**	**906**	**993**	**1,088**
Currently Available Water Supplies						
Direct Reuse (Denton)	646	733	819	906	993	1,088
Total Current Supplies	***646***	***733***	***819***	***906***	***993***	***1,088***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Double Oak

Double Oak is a city of about 3,000 people in southern Denton County. Cross Timbers WSC provides retail water service to the residents of Double Oak, and Cross Timbers WSC's water supply comes from groundwater (Trinity aquifer) and UTRWD. Water management strategies for Double Oak are conservation and additional water from Cross Timbers WSC. Table 5D.100 shows the projected population and demand, the current supplies, and the water management strategies for Double Oak.

Table 5D.100
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Double Oak

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,000**	**3,000**	**3,000**	**3,000**	**3,000**	**3,000**
Projected Water Demand						
Municipal Demand	558	547	539	534	533	533
Total Projected Water Demand	***558***	***547***	***539***	***534***	***533***	***533***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Currently Available Water Supplies						
Cross Timbers WSC (Groundwater)	325	325	325	325	325	325
Cross Timbers WSC (UTRWD)	233	199	170	151	146	128
Total Current Supplies	***558***	***524***	***495***	***476***	***471***	***453***
Need (Demand - Current Supply)	***0***	***23***	***44***	***58***	***62***	***80***
Water Management Strategies						
Water Conservation	10	15	16	18	20	21
Add'l Cross Timbers WSC (UTRWD)	0	40	92	138	172	189
Total Water Management Strategies	***10***	***55***	***108***	***156***	***192***	***210***
Reserve (Shortage)	**10**	**32**	**64**	**98**	**130**	**130**

Flower Mound

Flower Mound is a city of about 66,000 people in southern Denton County. The city obtains its water supply from DWU and UTRWD. Water management strategies for Flower Mound are conservation, additional water from DWU, and additional water from UTRWD. Table 5D.101 shows the projected population and demand, the current supplies, and the water management strategies for Flower Mound.

Table 5D.101
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Flower Mound

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**75,555**	**93,000**	**93,000**	**93,000**	**93,000**	**93,000**
Projected Water Demand						
Municipal Demand	19,049	23,148	23,022	22,948	22,924	22,922
Total Projected Demand	***19,049***	***23,148***	***23,022***	***22,948***	***22,924***	***22,922***
Currently Available Water Supplies						
UTRWD	10,477	11,297	8,763	6,929	6,162	5,401
Dallas Water Utilities	6,166	6,166	6,166	6,166	5,817	5,540
Total Current Supplies	***16,643***	***17,462***	***14,929***	***13,094***	***11,979***	***10,941***
Need (Demand - Current Supply)	***2,407***	***5,686***	***8,093***	***9,854***	***10,945***	***11,981***
Water Management Strategies						
Water Conservation	349	597	691	765	841	917
Additional Water from UTRWD	0	2,685	5,082	6,825	7,529	8,243

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from DWU and additional pipeline	2,249	2,404	2,320	2,264	2,574	2,822
Total Water Management Strategies	***2,598***	***5,686***	***8,093***	***9,854***	***10,945***	***11,981***
Reserve (Shortage)	**192**	**0**	**0**	**0**	**0**	**0**

Fort Worth

Fort Worth is a city of about 781,000 located primarily in Tarrant County, with some population in Denton, Parker, and Wise Counties in Region C and in Johnson County in Region G. Fort Worth is a wholesale water provider, and the city's water supply plans are discussed in Section 5C.1.

Frisco

The City of Frisco is a rapidly growing community in west Collin County and east Denton County. The city has a population of about 137,000 and is expected to continue to grow rapidly. Water supply strategies are discussed under Collin County in Section 5D.1.

Hackberry

Hackberry is a city of about 1,000 in eastern Denton County. The city receives its water supply from NTMWD. Water management strategies for Hackberry are conservation and additional water from NTMWD, including increase in delivery infrastructure from NTWMD. Table 5D.102 shows the projected population and demand, the current supplies, and the water management strategies for Hackberry.

Table 5D.102
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Hackberry

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (In City Only)	**1,274**	**1,645**	**2,088**	**2,583**	**3,162**	**3,823**
Projected Water Demand						
Municipal Demand	309	394	498	615	752	908
Total Projected Demand	***309***	***394***	***498***	***615***	***752***	***908***
Currently Available Water Supplies						
North Texas Municipal Water District	285	302	352	409	469	524
Total Current Supplies	***285***	***302***	***352***	***409***	***469***	***524***
Need (Demand - Current Supply)	***24***	***92***	***146***	***206***	***283***	***384***
Water Management Strategies						
Water Conservation	6	10	15	21	28	36

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from NTMWD	18	82	131	185	255	348
Increase delivery infrastructure from NTWMD	*0*	*0*	*0*	*70*	*200*	*348*
Total Water Management Strategies	***24***	***92***	***146***	***206***	***283***	***384***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Hickory Creek

Hickory Creek is a city of about 3,300 people in central Denton County. The city gets its water supply from Lake Cities MUA, which uses groundwater and UTRWD. Water management strategies for Hickory Creek are conservation and additional water from Lake Cities MUA. Table 5D.103 shows the projected population and demand, the current supplies, and the water management strategies for Hickory Creek.

Table 5D.103
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Hickory Creek

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,089**	**5,110**	**6,331**	**7,941**	**7,941**	**7,941**
Projected Water Demand						
Municipal Demand	583	709	865	1,078	1,076	1,076
Total Projected Demand	***583***	***709***	***865***	***1,078***	***1,076***	***1,076***
Currently Available Water Supplies						
Lake Cities Municipal Utility Authority (Groundwater)	97	97	97	97	97	97
Lake Cities Municipal Utility Authority (UTRWD)	486	485	475	481	432	379
Total Current Supplies	***583***	***582***	***572***	***578***	***529***	***476***
Need (Demand - Current Supply)	***0***	***127***	***293***	***500***	***547***	***600***
Water Management Strategies						
Water Conservation	5	8	9	14	18	22
Additional Water from Lake Cities MUA (UTRWD)	0	129	304	516	568	617
Total Water Management Strategies	***5***	***137***	***313***	***530***	***586***	***639***
Reserve (Shortage)	**5**	**10**	**20**	**30**	**39**	**39**

Highland Village

The City of Highland Village is located in southern Denton County and has a population of about 15,000. The city receives its water supply from groundwater and UTRWD. Water management strategies for Highland Village are conservation and additional water from UTRWD. Table 5D.104 shows the projected population and demand, the current supplies, and the water management strategies for Highland Village.

Table 5D.104
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Highland Village

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**17,100**	**18,000**	**18,000**	**18,000**	**18,000**	**18,000**
Projected Water Demand						
Municipal Demand	3,832	3,968	3,924	3,899	3,893	3,893
Total Projected Demand	***3,832***	***3,968***	***3,924***	***3,899***	***3,893***	***3,893***
Currently Available Water Supplies						
Trinity Aquifer	1,347	1,347	1,347	1,347	1,347	1,347
UTRWD	2,485	2,169	1,747	1,441	1,338	1,172
Total Current Supplies	***3,832***	***3,516***	***3,094***	***2,788***	***2,685***	***2,519***
Need (Demand - Current Supply)	***0***	***452***	***830***	***1,111***	***1,208***	***1,374***
Water Management Strategies						
Water Conservation	70	105	118	130	143	156
Additional Water from UTRWD	0	482	980	1,389	1,604	1,757
Total Water Management Strategies	***70***	***587***	***1,098***	***1,519***	***1,747***	***1,913***
Reserve (Shortage)	**70**	**135**	**268**	**408**	**539**	**539**

Justin

Justin has a population of about 3,200 and is located in southwest Denton County. The city receives its water supply from groundwater (Trinity aquifer) and UTRWD. Water management strategies for Justin are conservation, a new groundwater well, and additional water from UTRWD. Table 5D.105 shows the projected population and demand, the current supplies, and the water management strategies for Justin.

Table 5D.105
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Justin

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**4,650**	**8,325**	**12,000**	**12,000**	**12,000**	**12,000**
Projected Water Demand						
Municipal Demand	695	1,212	1,733	1,729	1,728	1,727
Total Projected Demand	***695***	***1,212***	***1,733***	***1,729***	***1,728***	***1,727***
Currently Available Water Supplies						
Upper Trinity Regional Water District	209	610	825	677	623	546
Trinity Aquifer	242	242	242	242	242	242
Total Current Supplies	***451***	***852***	***1,067***	***920***	***865***	***788***
Need (Demand - Current Supply)	***244***	***360***	***666***	***809***	***863***	***939***
Water Management Strategies						
Water Conservation	6	12	17	23	29	35
New Well	244	244	244	244	244	244
Additional Water from UTRWD	0	153	502	691	785	855
Total Water Management Strategies	***250***	***409***	***763***	***957***	***1,058***	***1,134***
Reserve (Shortage)	**6**	**49**	**97**	**148**	**195**	**195**

Krugerville

Krugerville has a population of about 1,700 in central Denton County. The city gets is water from Mustang SUD, and this water comes from UTRWD. Water management strategies for Krugerville are conservation and additional water from Mustang SUD. Table 5D.106 shows the projected population and demand, the current supplies, and the water management strategies for Krugerville.

Table 5D.106
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Krugerville

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**1,986**	**2,437**	**2,889**	**3,440**	**3,440**	**3,440**
Projected Water Demand						
Municipal Demand	263	315	368	435	434	434
Total Projected Demand	***263***	***315***	***368***	***435***	***434***	***434***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Mustang Special Utility District (UTRWD)	262	249	225	212	189	165
Total Current Supplies	***262***	***249***	***225***	***212***	***189***	***165***
Need (Demand - Current Supply)	***1***	***66***	***143***	***223***	***245***	***269***
Water Management Strategies						
Water Conservation	2	3	4	6	7	9
Additional Mustang SUD (UTRWD)	0	63	139	217	238	260
Total Water Management Strategies	***2***	***66***	***143***	***223***	***245***	***269***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Krum

The City of Krum is located in central Denton County and has a population of about 4,700. The city receives its water supply from groundwater (Trinity aquifer) and UTRWD. Water management strategies for Krum are conservation, additional water from UTRWD, and additional groundwater through new wells (Trinity aquifer). Table 5D.107 shows the projected population and demand, the current supplies, and the water management strategies for Krum.

Table 5D.107
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Krum

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**5,195**	**6,453**	**7,957**	**9,637**	**11,603**	**13,848**
Projected Water Demand						
Municipal Demand	1,154	1,414	1,731	2,089	2,512	2,997
Total Projected Demand	***1,154***	***1,414***	***1,731***	***2,089***	***2,512***	***2,997***
Currently Available Water Supplies						
Upper Trinity Regional Water District	707	797	843	866	973	1,037
Trinity Aquifer	448	448	448	448	448	448
Total Current Supplies	***1,155***	***1,245***	***1,291***	***1,314***	***1,421***	***1,485***
Need (Demand - Current Supply)	***0***	***169***	***440***	***775***	***1,091***	***1,512***
Water Management Strategies						
Water Conservation	21	36	52	70	92	120
Additional Water from UTRWD	0	179	478	842	1,180	1,573

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Groundwater (new wells)	577	707	866	1,025	1,025	1,025
Total Water Management Strategies	***598***	***922***	***1,396***	***1,937***	***2,297***	***2,718***
Reserve (Shortage)	**599**	**753**	**955**	**1,162**	**1,206**	**1,206**

Lake Dallas

Lake Dallas is a city of about 7,200 people in central Denton County. The city gets its water supply from Lake Cities MUA, which uses groundwater and water from UTRWD. Water management strategies for Lake Dallas are conservation and additional water from Lake Cities MUA. Table 5D.108 shows the projected population and demand, the current supplies, and the water management strategies for Lake Dallas.

Table 5D.108
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Lake Dallas

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**7,782**	**8,603**	**9,933**	**9,933**	**9,933**	**9,933**
Projected Water Demand						
Municipal Demand	1,096	1,181	1,339	1,329	1,326	1,326
Total Projected Demand	***1,096***	***1,181***	***1,339***	***1,329***	***1,326***	***1,326***
Currently Available Water Supplies						
Lake Cities Municipal Utility Authority (Groundwater)	182	182	182	182	182	182
Lake Cities Municipal Utility Authority (UTRWD)	913	804	736	593	533	468
Total Current Supplies	***1,095***	***986***	***917***	***774***	***715***	***650***
Need (Demand - Current Supply)	***1***	***195***	***422***	***555***	***611***	***676***
Water Management Strategies						
Water Conservation	9	13	13	18	22	27
Additional Water from Lake Cities MUA (UTRWD)	0	200	444	591	662	722
Total Water Management Strategies	***9***	***213***	***457***	***609***	***684***	***749***
Reserve (Shortage)	**8**	**18**	**36**	**55**	**73**	**73**

Lakewood Village

Lakewood Village is a city of about 560 people in southwest Denton County. The city gets its water supply from groundwater. Water management strategies for Lakewood Village are conservation and connecting to Upper Trinity Regional Water District. Table 5D.109 shows the projected population and demand, the current supplies, and the water management strategies for Lakewood Village.

Table 5D.109
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Lakewood Village

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**692**	**870**	**1,082**	**1,319**	**1,597**	**1,914**
Projected Water Demand						
Municipal Demand	83	102	125	151	182	218
Total Projected Demand	***83***	***102***	***125***	***151***	***182***	***218***
Currently Available Water Supplies						
Woodbine Aquifer	218	218	218	218	218	218
Total Current Supplies	***218***	***218***	***218***	***218***	***218***	***218***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	2	3	4
Upper Trinity Regional Water District	0	0	0	0	49	84
Total Water Management Strategies	***1***	***1***	***1***	***2***	***52***	***88***
Reserve (Shortage)	**136**	**117**	**94**	**69**	**88**	**88**

Lewisville

Lewisville is a city of about 98,000 people in southern Denton County, with a small area in Dallas County. Lewisville provides water supply to a portion of Denton County Freshwater Supply District 1A. Lewisville receives its water supply from DWU. Its water management strategies are conservation and additional water from DWU with future treatment plant expansions. Table 5D.110 shows the projected population and demand, the current supplies, and the water management strategies for Lewisville.

Table 5D.110
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Lewisville

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**107,327**	**121,924**	**139,368**	**158,857**	**177,356**	**177,356**
Projected Water Demand						
Municipal Demand	20,143	22,441	25,330	28,689	31,974	31,970
Customer Demand (Denton Co FWSD1A)	1,207	2,143	2,566	2,565	2,564	2,564
Total Projected Demand	***21,350***	***24,584***	***27,896***	***31,254***	***34,538***	***34,534***
Currently Available Water Supplies						
Dallas (for Lewisville)	19,207	19,442	19,340	19,551	19,718	19,718
Dallas (Denton Co FWSD1A)	1,151	1,857	1,959	1,748	1,581	1,581
Total Current Supplies	***20,358***	***21,299***	***21,299***	***21,299***	***21,299***	***21,299***
Need (Demand - Current Supply)	***992***	***3,285***	***6,597***	***9,955***	***13,239***	***13,235***
Water Management Strategies						
Water Conservation	382	619	799	1,004	1,228	1,334
Water Conservation (DCFWSD1A)	67	159	233	259	285	311
Additional Water from DWU with Treatment Expansions below:	543	2,507	5,565	8,692	11,726	11,590
6 MGD WTP Expansion-2030		*1,386*	*3,363*	*3,363*	*3,363*	*3,363*
6 MGD WTP Expansion-2040			*1,081*	*3,363*	*3,363*	*3,363*
7 MGD WTP Expansion-2050				*845*	*3,879*	*3,743*
Total Water Management Strategies	***992***	***3,285***	***6,597***	***9,955***	***13,239***	***13,235***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Little Elm

The Town of Little Elm has a current (2015) population of about 31,000 and is located in eastern Denton County. It should be noted that the population projections used in this plan and approved by TWDB in 2013 were developed prior to some substantial growth that has occurred in Little Elm and its wholesale customer area over the last few years. The town now estimates their buildout population to be around 53,000. These new estimates will be incorporated into the next regional water planning cycle for the 2021 Region C Water Plan. The town receives its water supply from groundwater (Woodbine aquifer) and NTMWD, but does not plan to use groundwater in the future. Little Elm provides wholesale water supply to Denton County Fresh Water Supply District #8 (included in this Region C Water Plan as part of the Denton County Other WUG). Water management strategies for Little Elm are conservation and additional water from NTMWD. Existing delivery facilities from NTMWD are anticipated to be adequate for all future water needs so no infrastructure strategies with capital costs are needed. Table 5D.111 shows the projected population and demand, the current supplies, and the water management strategies for Little Elm.

Table 5D.111
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Town of Little Elm

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population-Little Elm	**29,860**	**33,821**	**33,821**	**33,821**	**33,821**	**33,821**
Projected Population-Customers	**14,390**	**14,390**	**14,390**	**14,390**	**14,390**	**14,390**
Projected Water Demand						
Municipal Demand	4,108	4,600	4,586	4,574	4,564	4,564
Denton County Other (partial)	1,800	1,800	1,800	1,800	1,800	1,800
Total Projected Demand	***5,908***	***6,400***	***6,386***	***6,374***	***6,364***	***6,364***
Currently Available Water Supplies						
North Texas Municipal Water Dist.	3,785	3,525	3,239	3,045	2,847	2,636
NTWMD for Denton Co Other	1,659	1,379	1,271	1,198	1,123	1,040
Total Current Supplies	***5,444***	***4,904***	***4,510***	***4,243***	***3,970***	***3,675***
Need (Demand - Current Supply)	***464***	***1,496***	***1,876***	***2,131***	***2,394***	***2,689***
Water Management Strategies						
Water Conservation	34	51	46	61	76	91
Water Conservation (customers)	8	12	8	9	9	11
Additional Water from NTMWD	289	1,024	1,301	1,468	1,641	1,837
Add'l Water from NTMWD for Denton Co Other	134	409	521	593	668	749
Total Water Management Strategies	***465***	***1,496***	***1,876***	***2,131***	***2,394***	***2,689***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Mountain Spring Water Supply Corporation

Mountain Spring WSC serves a population of about 2,500 in northern Denton County and southern Cooke County. Since most of the population is in Cooke County, its water supply plans are discussed in Section 5D.2 under Cooke County.

Mustang Special Utility District

Mustang SUD serves about 6,900 people in northeastern Denton County. The SUD is a wholesale water provider, and the discussion of its water supply plans is in Section 5C.2.

Northlake

Northlake is a city of about 2,150 people in southwestern Denton County and is supplied from groundwater (Woodbine aquifer), Fort Worth (TRWD), and UTRWD. Northlake supplies a small amount of Denton County Manufacturing demand. Water management strategies for Northlake are conservation, and additional water from Fort Worth and UTRWD. Table 5D.112 shows the projected population and demand, the current supplies, and the water management strategies for Northlake.

Table 5D.112
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Northlake

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,500**	**17,000**	**31,010**	**43,005**	**55,000**	**55,000**
Projected Water Demand						
Municipal Demand	911	3,402	6,198	8,591	10,986	10,986
Denton Co Manufacturing Demand	14	16	18	20	22	24
Total Projected Demand	***925***	***3,418***	***6,216***	***8,611***	***11,008***	***11,010***
Currently Available Water Supplies						
Woodbine Aquifer	170	170	170	170	170	170
Fort Worth (TRWD)	160	573	906	1,141	1,341	1,233
Fort Worth (TRWD) (for Manufacturing)	14	15	14	14	14	14
Upper Trinity Regional Water District	578	1,984	2,887	3,199	3,658	3,206
Total Current Supplies	***922***	***2,742***	***3,977***	***4,524***	***5,183***	***4,622***
Need (Demand - Current Supply)	***3***	***676***	***2,239***	***4,087***	***5,825***	***6,388***
Water Management Strategies						
Water Conservation	17	78	186	286	403	439
Additional Fort Worth (TRWD)	0	122	380	650	952	1,052
Add'l Water from Fort Worth (TRWD, for Manufacturing)	0	1	4	5	7	9
Upper Trinity Regional Water District	0	479	1,674	3,151	4,469	4,893
Total Water Management Strategies	***17***	***680***	***2,244***	***4,092***	***5,831***	***6,394***
Reserve (Shortage)	**14**	**4**	**5**	**5**	**5**	**6**

Oak Point

Oak Point is a city of about 3,000 in central Denton County. The residents of Oak Point are provided retail water service by Mustang SUD, and the water supply comes from UTRWD. Water management strategies for Oak Point are conservation and additional water from Mustang SUD. Table 5D.113 shows the projected population and demand, the current supplies, and the water management strategies for Oak Point.

Table 5D.113
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Oak Point

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**8,305**	**12,586**	**16,868**	**21,149**	**25,430**	**25,430**
Projected Water Demand						
Municipal Demand	1,053	1,572	2,097	2,624	3,153	3,152
Total Projected Demand	***1,053***	***1,572***	***2,097***	***2,624***	***3,153***	***3,152***
Currently Available Water Supplies						
Mustang SUD (UTRWD)	788	1,050	1,157	1,188	1,299	1,138
Trinity Aquifer	264	264	264	264	264	264
Total Current Supplies	***1,052***	***1,314***	***1,421***	***1,452***	***1,563***	***1,402***
Need (Demand - Current Supply)	***1***	***258***	***676***	***1,172***	***1,590***	***1,750***
Water Management Strategies						
Water Conservation	9	16	21	35	53	63
Additional Mustang SUD (UTRWD)	0	268	707	1,217	1,643	1,793
Total Water Management Strategies	***9***	***284***	***728***	***1,252***	***1,696***	***1,856***
Reserve (Shortage)	**8**	**26**	**52**	**80**	**106**	**106**

Paloma Creek

Paloma Creek is a city of about 8,400 in central/eastern Denton County, and is provided water by UTRWD, with Mustang SUD acting as the contract operator of Paloma Creek’s water system. Water management strategies for Paloma Creek are conservation and additional water from UTRWD. Table 5D.114 shows the projected population and demand, the current supplies, and the water management strategies for Paloma Creek.

Table 5D.114
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Paloma Creek

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**12,348**	**16,839**	**16,839**	**16,839**	**16,839**	**16,839**
Projected Water Demand						
Municipal Demand	2,562	3,472	3,470	3,468	3,465	3,464
Total Projected Demand	***2,562***	***3,472***	***3,470***	***3,468***	***3,465***	***3,464***
Currently Available Water Supplies						
UTRWD	2,561	2,733	2,130	1,689	1,502	1,184
Total Current Supplies	***2,561***	***2,733***	***2,130***	***1,689***	***1,502***	***1,184***
Need (Demand - Current Supply)	***1***	***739***	***1,340***	***1,779***	***1,963***	***2,280***
Water Management Strategies						
Water Conservation	47	88	104	116	127	139
Additional Water from UTRWD	0	651	1,236	1,663	1,836	2,141
Total Water Management Strategies	***47***	***739***	***1,340***	***1,779***	***1,963***	***2,280***
Reserve (Shortage)	**46**	**0**	**0**	**0**	**0**	**0**

Pilot Point

Pilot Point has a population of about 3,900 and is located in northern Denton County. The city receives its water supply from groundwater (Trinity aquifer). Water management strategies for Pilot Point are conservation, establishing a direct connection to UTRWD and purchasing water from UTRWD, and additional water from Trinity aquifer (new wells). Table 5D.115 shows the projected population and demand, the current supplies, and the water management strategies for Pilot Point.

Table 5D.115
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Pilot Point

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,500**	**8,000**	**11,000**	**15,000**	**20,000**	**27,000**
Projected Water Demand						
Municipal Demand	891	1,070	1,449	1,965	2,615	3,527
Total Projected Demand	***891***	***1,070***	***1,449***	***1,965***	***2,615***	***3,527***
Currently Available Water Supplies						
Trinity Aquifer	1,102	1,102	1,102	1,102	1,102	1,102

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***1,102***	***1,102***	***1,102***	***1,102***	***1,102***	***1,102***
Need (Demand - Current Supply)	***0***	***0***	***347***	***863***	***1,513***	***2,425***
Water Management Strategies						
Water Conservation	7	12	14	26	44	71
Additional Trinity Aquifer (new wells)	269	269	269	269	269	269
Upper Trinity Regional Water District	0	0	68	715	1,481	2,366
Total Water Management Strategies	***276***	***281***	***351***	***1,010***	***1,794***	***2,706***
Reserve (Shortage)	**487**	**313**	**4**	**147**	**281**	**281**

Plano

Plano is a city of about 269,000 located in southwest Collin County and southeast Denton County. The water supply plans for Plano are discussed under Collin County in Section 5D.1.

Ponder

Ponder is a city of about 1,500 located in western Denton County. The city receives its water supply from groundwater (Trinity aquifer). Water management strategies for Ponder are conservation and establishing a direct connection to UTRWD and purchasing water from UTRWD. Table 5D.116 shows the projected population and demand, the current supplies, and the water management strategies for Ponder.

Table 5D.116
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Ponder

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,035**	**2,811**	**3,738**	**4,774**	**5,987**	**7,371**
Projected Water Demand						
Municipal Demand	254	343	451	574	718	883
Total Projected Demand	***254***	***343***	***451***	***574***	***718***	***883***
Currently Available Water Supplies						
Trinity Aquifer	476	476	476	476	476	476
Total Current Supplies	***476***	***476***	***476***	***476***	***476***	***476***
Need (Demand - Current Supply)	***0***	***0***	***0***	***98***	***242***	***407***
Water Management Strategies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Conservation	2	4	5	8	12	18
Upper Trinity Regional Water District	0	0	65	235	421	580
Total Water Management Strategies	***2***	***4***	***70***	***243***	***433***	***598***
Reserve (Shortage)	**224**	**137**	**95**	**145**	**191**	**191**

Prosper

The City of Prosper is located in western Collin County and eastern Denton County and has a population of about 14,700. Water management strategies for Prosper are described under Collin County in Section 5D.1.

Providence Village Water Control and Improvement District (WCID)

Providence Village WCID serves about 5,200 people in central/eastern Denton County, and is provided water by UTRWD, with Mustang SUD acting as the contract operator of Providence Village WCID's water system. Water management strategies for Providence Village WCID are conservation and additional water from UTRWD. Table 5D.117 shows the projected population and demand, the current supplies, and the water management strategies for Providence Village WCID.

Table 5D.117
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Providence Village WCID

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**7,235**	**7,235**	**7,235**	**7,235**	**7,235**	**7,235**
Projected Water Demand						
Municipal Demand	938	931	929	927	926	925
Total Projected Demand	***938***	***931***	***929***	***927***	***926***	***925***
Currently Available Water Supplies						
UTRWD	938	733	570	450	402	352
Total Current Supplies	***938***	***733***	***570***	***450***	***402***	***352***
Need (Demand - Current Supply)	***0***	***198***	***359***	***477***	***524***	***573***
Water Management Strategies						
Water Conservation	8	11	9	12	15	19
Additional UTRWD	0	187	350	465	509	554
Total Water Management Strategies	***8***	***198***	***359***	***477***	***524***	***573***
Reserve (Shortage)	**8**	**0**	**0**	**0**	**0**	**0**

Roanoke

Roanoke has a population of about 6,750 in southwestern Denton County. The city receives its water supply from Fort Worth (TRWD). Water management strategies for Roanoke are conservation and additional water from Fort Worth. Table 5D.118 shows the projected population and demand, the current supplies, and the water management strategies for Roanoke.

Table 5D.118
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Roanoke

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**7,975**	**9,988**	**12,000**	**12,000**	**12,000**	**12,000**
Projected Water Demand						
Municipal Demand	2,263	2,807	3,356	3,350	3,348	3,348
Total Projected Demand	***2,263***	***2,807***	***3,356***	***3,350***	***3,348***	***3,348***
Currently Available Water Supplies						
Fort Worth (TRWD)	2,219	2,264	2,294	2,062	1,886	1,734
Total Current Supplies	***2,219***	***2,264***	***2,294***	***2,062***	***1,886***	***1,734***
Need (Demand - Current Supply)	***44***	***543***	***1,062***	***1,288***	***1,462***	***1,614***
Water Management Strategies						
Water Conservation	44	78	108	119	130	141
Additional Fort Worth (TRWD)	0	465	954	1,169	1,332	1,473
Total Water Management Strategies	***44***	***543***	***1,062***	***1,288***	***1,462***	***1,614***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Sanger

Sanger is a city of about 7,500 located in northern Denton County. The city gets its water supply from groundwater (Trinity aquifer) and from Upper Trinity Regional Water District. Water management strategies for Sanger are conservation and additional water from UTRWD. Table 5D.119 shows the projected population and demand, the current supplies, and the water management strategies for Sanger.

Table 5D.119
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Sanger

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**8,632**	**10,713**	**13,199**	**15,977**	**19,229**	**22,941**
Projected Water Demand						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Municipal Demand	1,202	1,452	1,763	2,119	2,545	3,034
Total Projected Demand	***1,202***	***1,452***	***1,763***	***2,119***	***2,545***	***3,034***
Currently Available Water Supplies						
Trinity Aquifer	1,121	1,121	1,121	1,121	1,121	1,121
Upper Trinity Regional Water District	78	346	529	650	811	897
Total Current Supplies	***1,199***	***1,468***	***1,650***	***1,771***	***1,932***	***2,018***
Need (Demand - Current Supply)	***3***	***0***	***113***	***348***	***613***	***1,016***
Water Management Strategies						
Water Conservation	10	16	18	28	42	61
Additional Water from UTRWD	0	78	315	657	1,018	1,402
Total Water Management Strategies	***10***	***94***	***333***	***685***	***1,060***	***1,463***
Reserve (Shortage)	**7**	**109**	**220**	**337**	**447**	**447**

Shady Shores

Shady Shores is a city of about 2,600 people in central Denton County. The city gets its water supply from Lake Cities MUA, which uses groundwater and water from UTRWD. Water management strategies for Shady Shores are conservation and additional water from Lake Cities MUA. Table 5D.120 shows the projected population and demand, the current supplies, and the water management strategies for Shady Shores.

Table 5D.120
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Shady Shores

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,441**	**3,936**	**3,936**	**3,936**	**3,936**	**3,936**
Projected Water Demand						
Municipal Demand	461	516	511	508	507	506
Total Projected Demand	***461***	***516***	***511***	***508***	***507***	***506***
Currently Available Water Supplies						
Lake Cities Municipal Utility Authority (Groundwater)	76	76	76	76	76	76
Lake Cities Municipal Utility Authority (UTRWD)	385	352	281	226	204	178
Total Current Supplies	***461***	***429***	***357***	***303***	***280***	***255***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***0***	***87***	***154***	***205***	***227***	***251***
Water Management Strategies						
Water Conservation	4	6	5	7	8	10
Add'l Lake Cities MUA (UTRWD)	0	89	164	222	249	272
Total Water Management Strategies	***4***	***95***	***169***	***229***	***257***	***282***
Reserve (Shortage)	**4**	**7**	**15**	**23**	**30**	**30**

Southlake

Southlake is a city of about 27,300 in northwestern Tarrant County, with some area in southern Denton County. Water management strategies for Southlake are described under Tarrant County in Section 5D.15.

The Colony

The Colony is a city of about 39,000 in southeastern Denton County. The city receives its water supply from groundwater (Trinity aquifer), DWU, and Plano (NTWMD sources). Water management strategies for The Colony are conservation, additional water from DWU, and additional water from Plano. Table 5D.121 shows the projected population and demand, the current supplies, and the water management strategies for The Colony.

Table 5D.121
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of The Colony

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**51,000**	**58,000**	**62,000**	**67,600**	**67,600**	**67,600**
Projected Water Demand						
Municipal Demand	7,762	8,632	9,106	9,857	9,844	9,841
Total Projected Demand	***7,762***	***8,632***	***9,106***	***9,857***	***9,844***	***9,841***
Currently Available Water Supplies						
Trinity Aquifer	1,327	1,327	1,327	1,327	1,327	1,327
Dallas Water Utilities	4,992	4,600	4,320	4,377	3,952	3,635
Plano (NTMWD)	1,106	1,532	1,554	1,598	1,622	1,617
Total Current Supplies	***7,425***	***7,459***	***7,201***	***7,302***	***6,901***	***6,579***
Need (Demand - Current Supply)	***337***	***1,173***	***1,905***	***2,555***	***2,943***	***3,262***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	65	96	91	131	164	197
Additional DWU	199	609	1,168	1,622	1,801	1,882
Additional Plano (NTMWD)	84	468	646	802	978	1,183
Total Water Management Strategies	***348***	***1,173***	***1,905***	***2,555***	***2,943***	***3,262***
Reserve (Shortage)	**11**	**0**	**0**	**0**	**0**	**0**

Trophy Club

Trophy Club has a population of about 10,100 in southern Denton County. Trophy Club MUD #1 provides retail service to the city of Trophy Club. The MUD currently receives its water supply from groundwater (Trinity aquifer) and Fort Worth (TRWD), but plans to discontinue use of groundwater before 2020. Water management strategies for Trophy Club are conservation and additional water from Fort Worth. The additional water from Fort Worth will require an increase in delivery infrastructure, which will take place in two phases. The first phase will be a joint project with Fort Worth and Westlake. The second phase will be an extension of the first phase and will be a dedicated line for Trophy Club MUD #1. Table 5D.122 shows the projected population and demand, the current supplies, and the water management strategies for Trophy Club.

Table 5D.122
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of the Trophy Club

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**14,000**	**14,000**	**14,000**	**14,000**	**14,000**	**14,000**
Projected Water Demand						
Municipal Demand	6,125	6,094	6,075	6,064	6,061	6,060
Total Projected Demand	***6,125***	***6,094***	***6,075***	***6,064***	***6,061***	***6,060***
Currently Available Water Supplies						
Trinity Aquifer	600	0	0	0	0	0
Fort Worth (TRWD)	5,259	4,915	4,152	3,733	3,414	3,138
Total Current Supplies	***5,859***	***4,915***	***4,152***	***3,733***	***3,414***	***3,138***
Need (Demand - Current Supply)	***266***	***1,179***	***1,923***	***2,331***	***2,647***	***2,922***
Water Management Strategies						
Water Conservation	233	283	302	322	342	362

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from Fort Worth	33	896	1,621	2,009	2,305	2,560
Phase I-Increase delivery infrastructure from Ft Worth; joint project with Ft Worth, Westlake, Trophy Club	*33*	*896*	*1,621*	*2,009*	*2,305*	*2,560*
Phase II-Increase delivery infrastructure from Ft Worth; 24" line	*33*	*896*	*1,621*	*2,009*	*2,305*	*2,560*
Total Water Management Strategies	***266***	***1,179***	***1,923***	***2,331***	***2,647***	***2,922***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Westlake

Westlake is a city of about 1,000 in northern Tarrant County and southern Denton County. Since most of the population is in Tarrant County, its water supply plans are discussed under Tarrant County in Section 5D.15.

Costs for Denton County Water User Groups

Table 5D.123 shows the estimated capital costs for Denton County water management strategies not covered under the wholesale water providers, and Table 5D.124 summarizes the costs by category. Table 5D.124 is followed by a summary for Denton County.

Table 5D.123
Costs for Recommended Water Management Strategies for Denton County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Argyle	Conservation	2020	187	$111,288	$5.77	$1.52	Q-10
	Additional Argyle WSC (UTRWD)	2020	1,541	$0	$3.00	$3.00	None
Argyle WSC	Conservation	2020	51	$77,847	$2.86	$0.95	Q-10
	Other measures	See Argyle WSC in Section 5C.					
Aubrey	Conservation	2020	29	$13,559	$0.70	$0.00	Q-10
	Additional UTRWD supplies	2020	871	$0	$3.00	$3.00	None

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Bartonville	Conservation	2020	36	$34,394	$3.15	$1.18	Q-10
	Additional Cross Timbers WSC (UTRWD)	2030	459	$0	$3.00	$3.00	None
Bolivar WSC*	Conservation	2020	46	$22,380	$0.64	$0.00	Q-10
	UTRWD supplies	2020	1,413	$0	$3.00	$3.00	None
	Connect to Gainesville	2020	150	See Gainesville in Section 5C.			
Carrollton*	Conservation	2020	914	$2,580,390	$2.79	$0.60	Q-10
	Additional DWU supplies	2020	7,369	$0	$1.48	$1.48	None
Celina*	Conservation	See Collin County					
	Connect to NTMWD and supplies	See Collin County					
	Additional UTRWD supplies	See Collin County					
Coppell*	Conservation	See Dallas County.					
	Additional DWU supplies	See Dallas County.					
Copper Canyon	Conservation	2020	15	$7,738	$2.94	$1.24	Q-10
	Additional Cross Timbers WSC (UTRWD)	2020	152	$0	$3.00	$3.00	None
Corinth	Conservation	2020	210	$616,435	$4.49	$1.17	Q-10
	Additional UTRWD supplies	2030	1,804	$0	$3.00	$3.00	None
	Upsize existing well	2020	286	$2,372,900	$3.16	$1.02	Q-98
	New wells in Trinity Aquifer-2020	2020	561	$1,634,600	$1.40	$0.65	Q-96
	New wells in Trinity Aquifer-2030	2030	561	$1,634,600	$1.40	$0.65	Q-97
Cross Roads	Conservation	2020	30	$16,218	$2.98	$1.09	Q-10
	Additional Mustang SUD (UTRWD)	2020	437	$0	$3.00	$3.00	None
Dallas*	Conservation	See Dallas County.					
	Other measures	See DWU in Section 5C.1.					
Denton	Conservation	2020	3,966	$1,938,438	$2.16	$0.44	Q-10
	Other measures	See Denton in Section 5C.					

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Denton County FWSD #1A	Conservation	2020	311	$163,972	$2.32	$0.69	Q-10
	Additional UTRWD supplies	2020	3,019	$0	$3.00	$3.00	None
	Additional Lewisville supplies (DWU)	2020	889	$0	$2.50	$2.50	None
Denton County FWSD #10	Conservation	2020	132	$51,276	$3.06	$1.15	Q-10
	Additional Mustang SUD (UTRWD)	2030	1,131	$0	$3.00	$3.00	None
	Additional UTRWD	2030	676	$0	$3.00	$3.00	None
Denton County FWSD #7	Conservation	2020	143	$683,309	$4.55	$0.87	Q-10
	Additional UTRWD supplies	2030	1,963	$0	$3.00	$3.00	None
Denton County Other	Conservation	2020	390	$92,932	$0.75	$0.00	Q-10
	Additional Little Elm (NTWMD)	2030	749	$0	$2.50	$2.50	None
	Additional UTRWD supplies	2030	11,507	$0	$3.00	$3.00	None
	New wells in Trinity Aquifer	2020	504	$2,772,023	$3.08	$0.95	Q-102
	New wells in Woodbine Aquifer	2020	817	$11,691,860	$4.18	$1.18	Q-101
Double Oak	Conservation	2020	21	$17,324	$3.04	$1.23	Q-10
	Additional Mustang SUD (UTRWD)	2030	189	$0	$3.00	$3.00	None
Flower Mound	Conservation	2020	917	$1,062,719	$1.89	$0.48	Q-10
	Additional DWU supplies	2020	2,822	$0	$1.48	$1.48	None
	Additional UTRWD supplies	2030	8,243	$0	$3.00	$3.00	None
Fort Worth*	Conservation	See Tarrant County					
	Other measures	See Fort Worth in Section 5C.					
Frisco*	Conservation	See Collin County					
	Direct reuse	See Collin County					
	Additional NTMWD supplies	See Collin County					

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Hackberry	Conservation	2020	36	$10,906	$2.38	$0.91	Q-10
	Additional NTMWD supplies	2020	348	$0	$1.70	$1.70	None
	Increase delivery infrastructure from NTWMD	*2050*	*348*	$1,731,000	$1.54	$0.26	Q-103
Hickory Creek	Conservation	2020	22	$17,941	$0.92	$0.00	Q-10
	Additional Lake Cities MUA (UTRWD)	2020	617	$0	$3.00	$3.00	None
Highland Village	Conservation	2020	156	$544,339	$3.93	$0.91	Q-10
	Additional UTRWD supplies	2020	1,757	$0	$3.00	$3.00	None
Justin	Conservation	2020	35	$17,064	$0.73	$0.00	Q-10
	Additional UTRWD supplies	2030	855	$0	$3.00	$3.00	None
	New wells in Trinity Aquifer	2020	244	$2,115,500	$3.15	$0.93	Q-104
Krugerville	Conservation	2020	9	$7,419	$0.95	$0.00	Q-10
	Additional Mustang SUD (UTRWD)	2030	260	$0	$3.00	$3.00	None
Krum	Conservation	2020	120	$30,634	$2.48	$0.93	Q-10
	Additional UTRWD supplies	2030	1,573	$0	$3.00	$3.00	None
	New wells in Trinity Aquifer	2020	1,025	$1,533,200	$0.92	$0.54	Q-105
Lake Dallas	Conservation	2020	27	$34,026	$0.97	$0.00	Q-10
	Additional Lake Cities MUA (UTRWD)	2030	722	$0	$3.00	$3.00	None
Lakewood Village	Conservation	2020	4	$2,105	$0.54	$0.00	Q-10
	Connect to UTRWD	2060	84	$0	$3.00	$3.00	None
Lewisville*	Conservation	2020	1,334	$1,175,088	$2.37	$0.67	Q-10
	Additional DWU supplies	2020	11,726	$0	$1.48	$1.48	None
	6 MGD WTP Expansion-2030	*2030*	*3,363*	$17,433,000	$1.90	$0.57	Q-13
	6 MGD WTP Expansion-2040	*2040*	*3,363*	$17,433,000	$1.90	$0.57	Q-13
	7 MGD WTP Expansion-2050	*2050*	*3,879*	$19,565,000	$1.85	$0.55	Q-13

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Little Elm	Conservation	2020	91	$311,279	$2.35	$0.00	Q-10
	Additional NTMWD supplies	2020	1,837	$0	$1.75	$1.75	None
Mountain Spring WSC*	Conservation	See Cooke County					
	Connect to Gainesville	See Cooke County					
Mustang SUD	Conservation	2020	204	$186,398	$2.99	$0.00	Q-10
	Other measures	See Mustang SUD in Section 5C.2.					
Northlake	Conservation	2020	439	$171,715	$4.86	$0.73	Q-10
	Additional Fort Worth (TRWD)	2020	1,052	$0	$1.96	$1.96	None
	Additional UTRWD supplies	2030	4,893	$0	$3.00	$3.00	None
Oak Point	Conservation	2020	63	$41,117	$1.17	$0.00	Q-10
	Additional Mustang SUD (UTRWD)	2030	1,793	$0	$3.00	$3.00	None
Paloma Creek	Conservation	2020	139	$110,011	$2.75	$0.96	Q-10
	Additional UTRWD	2020	2,141	$0	$3.00	$3.00	None
Pilot Point	Conservation	2020	71	$37,796	$1.39	$0.00	Q-10
	Additional groundwater	2020	269	$865,605	$1.52	$0.70	Q-106
	UTRWD supplies	2040	2,366	$0	$3.00	$3.00	None
Plano*	Conservation	See Collin County					
	Additional NTMWD supplies	See Collin County					
Ponder	Conservation	2020	18	$21,028	$2.70	$0.00	Q-10
	UTRWD supplies	2040	580	$0	$3.00	$3.00	None
Prosper*	Conservation	See Collin County					
	Additional NTMWD supplies	See Collin County					
Providence Village WCID	Conservation	2020	19	$31,785	$1.02	$0.00	Q-10
	Additional UTRWD	2030	554	$0	$3.00	$3.00	None
Roanoke	Conservation	2020	141	$99,979	$2.32	$0.80	Q-10
	Additional Fort Worth (TRWD)	2020	1,473	$0	$1.96	$1.96	None
Sanger	Conservation	2020	61	$28,949	$0.74	$0.00	Q-10
	Additional UTRWD	2030	1,402	$0	$3.00	$3.00	None

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Shady Shores	Conservation	2020	10	$13,964	$0.90	$0.00	Q-10
	Additional Lake Cities MUA (UTRWD)	2020	272	$0	$3.00	$3.00	None
Southlake*	Conservation	See Tarrant County					
	Additional Fort Worth (TRWD)	See Tarrant County					
The Colony	Conservation	2020	197	$317,769	$1.26	$0.00	Q-10
	Additional DWU supplies	2020	1,882	$0	$1.48	$1.48	None
	Additional Plano (NTMWD)	2020	1,183	$0	$1.70	$1.70	None
Trophy Club	Conservation	2020	362	$338,556	$0.88	$0.33	Q-10
	Additional Fort Worth	2020	2,560	$0	$1.96	$1.96	None
	Phase I-Increase delivery infrastructure from Ft Worth; joint project with Ft Worth, Westlake, Trophy Club	*2020*	*2,560*	$2,273,000	$0.50	$0.04	Q-197
	Phase II-Increase delivery infrastructure from Ft Worth; 24" line	*2020*	*2,560*	$7,292,600	$0.80	$0.07	Q-198
Westlake*	Conservation	See Tarrant County					
	Additional Fort Worth (TRWD)	See Tarrant County					
	Increase delivery infrastructure from Ft Worth; joint project with Ft Worth, Westlake, Trophy Club	See Tarrant County					
Denton County Irrigation	Conservation	2020	124	$0	$0.95	$0.95	Q-11
	Additional direct reuse (UTRWD)	2030	2,240	See UTRWD in Section 5C.1.			
Denton County Livestock	None	None					
Denton County	Conservation	2030	68	$0	$0.95	$0.95	Q-11
	Additional Denton	2020	1,396	$0	$2.50	$2.50	None
	Additional DWU supplies	2020	56	$0	$1.48	$1.48	None

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Manufac-turing	Additional NTMWD supplies	2020	47	$0	$1.75	$1.75	None
	Additional UTRWD supplies	2030	141	$0	$3.00	$3.00	None
	Additional Northlake supplies	2040	9	$0	$2.50	$2.50	None
	Additional groundwater	2020	184	$777,700	$1.85	$0.77	Q-100
Denton County Mining	Additional UTRWD supplies	2030	2,688	$0	$3.00	$3.00	None
Denton County Steam Electric	None	None					

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.124
Summary of Recommended Water Management Strategies for Denton County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	11,148	$11,040,087
Purchase from WWP	77,307	$0
Purchase from WUG	14,338	$0
Delivery infrastructure	*5,468*	$11,296,600
Treatment Plants	10,605	$54,431,000
Reuse	2,240	$0
Groundwater	4,451	$25,397,989
Total		**$102,165,676**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

2010 Population: *662,614*

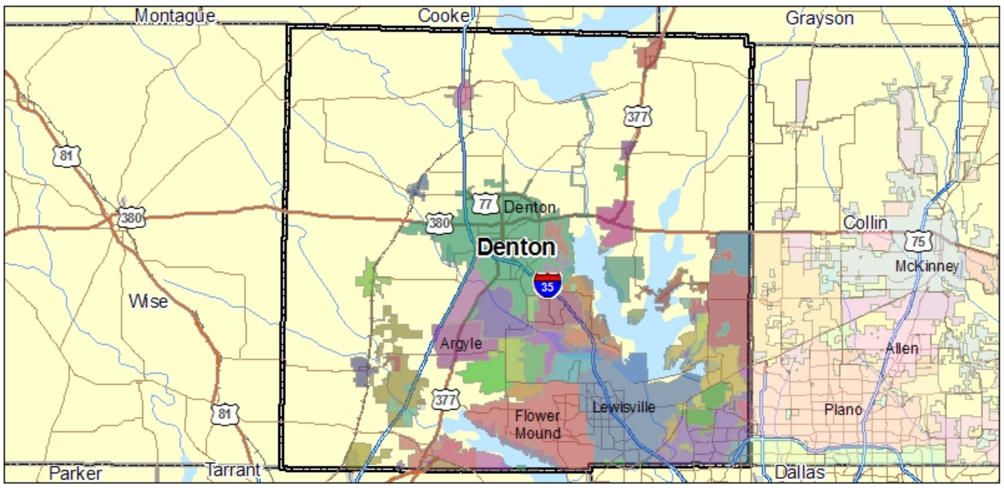
Projected 2070 Population: *2,090,485*

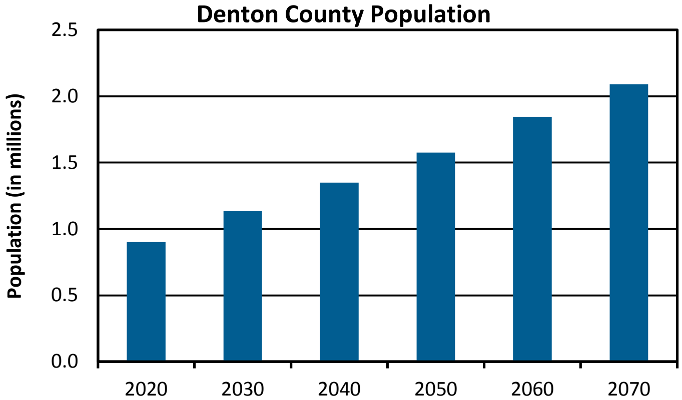
County Seat: *Denton*

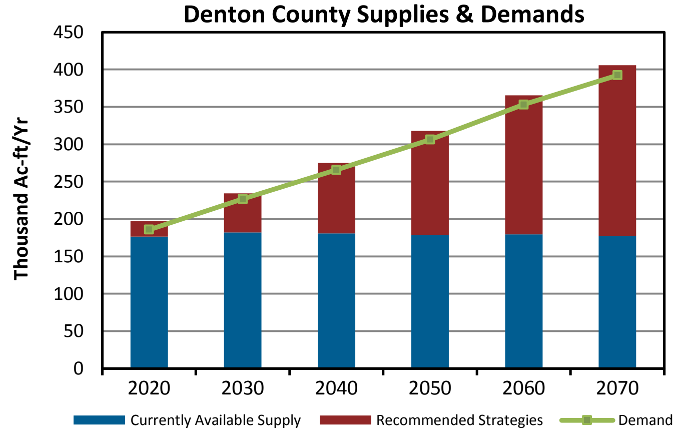
Economy: *Industry; tourism; government/services*

River Basin(s):

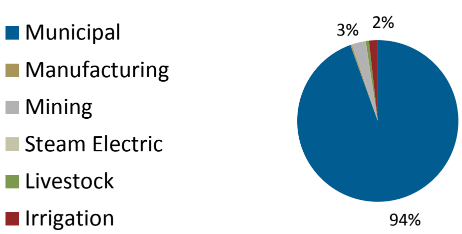
- Trinity (100%)





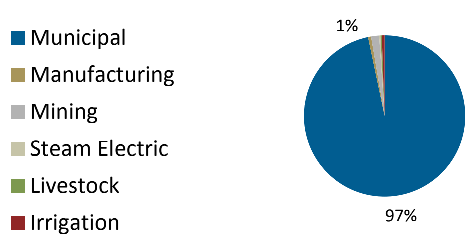


2010 Denton County Historical Demand
(% of total)



Total=119,635 acre-feet

2070 Denton County Projected Demand
(% of total)



Total= 392,342 acre-feet

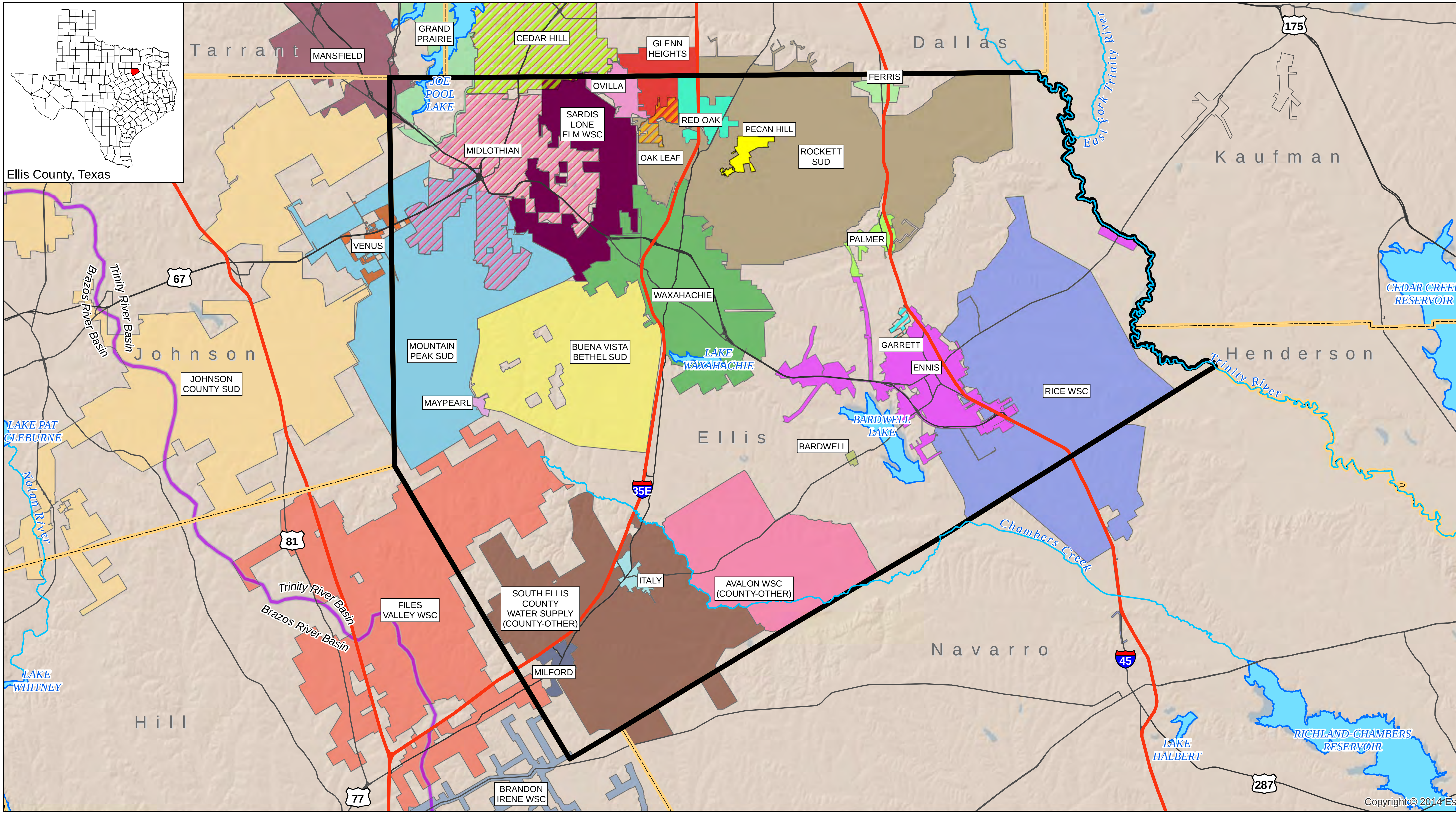
5D.5 Ellis County

Figure 5D.5 is a map of Ellis County. Current sources of water supply in Ellis County include:

- Joe Pool Lake (Trinity River Authority [TRA]) for Midlothian
- Bardwell Lake (TRA) for Ennis and Waxahachie
- Lake Waxahachie for Waxahachie
- Tarrant Regional Water District (TRWD) through TRA for Ennis, Rockett SUD, Waxahachie, and Midlothian
- Tarrant Regional Water District (TRWD) through Mansfield
- Reuse for Waxahachie and Steam Electric Power
- Dallas Water Utilities (DWU) for suppliers in the northern part of the county.
- Lake Aquilla and the Brazos Regional Public Utility Agency SWATS system (both in Region G) for suppliers in the western part of the county
- Groundwater.

Ellis County is in the Prairielands Groundwater Conservation District. Current groundwater pumping from the Trinity aquifer in Ellis County exceeds the modeled available groundwater as determined by the Texas Water Development Board (TWBD). The modeled available groundwater from the Trinity aquifer in Ellis County is 3,959 acre-feet per year. According to TWDB records, the pumping from the Trinity aquifer in Ellis County in 2011 was 4,703 acre-feet. As required by TWDB, this plan calls for the development of other sources of supply to eliminate the need for pumping from the aquifer beyond the modeled available groundwater volume. It is unclear if any entities will in fact decrease their pumping from the aquifer based on the recommendations in this plan. The 2011 pumping from the Woodbine aquifer in Ellis County was 3,679 acre-feet, less than the modeled available groundwater supply of 5,441 acre-feet per year. Thus, there is room for additional groundwater development from the Woodbine.

The TRA and local suppliers in Ellis County have begun to develop the Ellis County Water Supply Project which will supply increasing amounts of surface water (from TRWD) to customers in Ellis County (Table 5D.125). Water for the Ellis County Surface Water Supply Project will be delivered by the TRWD pipelines that run through Ellis County and will be treated at water treatment facilities operated by Ennis, Waxahachie/Rockett SUD, and Midlothian. This strategy will require water treatment plants and treatment plant expansions and treated water pipelines. The Ellis County Water Supply Project will be developed by a combination of TRA, Ennis, Midlothian, Waxahachie and other suppliers in the county.



FREESE AND NICHOLS

Project No: NTD11336

Service Areas | River Basin Divide
County Boundary | River
Ellis County Boundary | Reservoir

N S E W

1 inch = 4.5 miles

0 2.25 4.5 9

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Ellis County, Texas

Figure 5D.5

Table 5D.125
Projected Supplies from the Ellis County Water Supply Project

Water User Group	Demands and Supplies (Ac-Ft/Yr)					
	2020	2030	2040	2050	2060	2070
Ennis Municipal	4,148	4,789	5,447	7,397	11,879	19,748
Garrett	346	438	546	674	827	1,970
Rice WSC (part)	50	50	50	50	50	50
Ellis Co. Other	186	191	204	765	1,656	2,911
Ellis Co. Manufacturing (10%)	525	540	556	572	572	572
Ellis Co. Steam Electric	1,401	1,401	1,401	1,401	1,401	1,401
Total Demands	**6,656**	**7,409**	**8,204**	**10,859**	**16,385**	**26,652**
Other Supplies	6,109	5,944	6,228	6,868	8,938	8,901
Conservation	168	426	518	742	1,242	2,175
Ennis Supply from ECWSP	**379**	**1,039**	**1,458**	**3,249**	**6,205**	**15,576**
Midlothian Municipal	4,198	5,429	7,069	8,589	9,956	10,995
Grand Prairie (part)	3,363	3,363	3,363	3,363	3,363	3,363
Mountain Peak SUD (net of Groundwater)	414	852	1,370	1,983	2,714	3,563
Rockett SUD	2,242	2,242	2,242	2,242	2,242	2,242
Venus (Region G)	429	519	615	724	842	971
Ellis Co. Manufacturing (40%)	262	270	278	286	286	286
Ellis Co. Steam Electric	224	224	224	224	224	224
Sardis-Lone Elm WSC	1,121	1,121	1,121	1,121	1,121	1,121
Total Demands	**12,253**	**14,020**	**16,282**	**18,532**	**20,748**	**22,765**
Other Supplies	5,833	5,712	5,591	5,470	5,349	5,229
Conservation	129	232	349	615	1,068	1,313
Midlothian Supply from ECWSP	**6,291**	**8,076**	**10,342**	**12,447**	**14,331**	**16,223**
Rockett SUD Municipal	3,871	4,841	6,001	7,390	9,575	11,798
Bardwell	24	44	68	97	130	320
Ellis County Other (Boyce WSC and Bristol WSC)	519	519	519	519	519	519
Ellis County Other (future)	2,000	2,000	2,000	2,000	2,646	5,820
Ennis (part)	17	17	17	17	17	17
Ferris (net of Groundwater)	108	186	269	362	827	1,852
Lancaster (part)	90	90	90	90	90	90
Oak Leaf (part)	55	55	55	55	55	55
Palmer (net of Groundwater)	289	353	432	529	675	1,242
Pecan Hill	111	136	167	205	257	384
Red Oak (part)	1,230	1,230	1,230	1,230	1,230	1,230
Sardis-Lone Elm WSC (net of Groundwater)	2,166	3,055	4,086	4,600	4,950	4,948
Waxahachie (part)	613	613	613	613	613	613
Total Demands	**11,093**	**13,139**	**15,547**	**17,707**	**21,584**	**28,888**

Water User Group	Demands and Supplies (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
Other Supplies (Midlothian)	2,242	2,242	2,242	2,242	2,242	2,242
Conservation	126	208	272	372	503	692
Rockett SUD Supply from ECWSP	**8,725**	**10,689**	**13,033**	**15,093**	**18,839**	**25,954**
Waxahachie Municipal	6,872	7,741	9,320	11,299	13,749	16,715
Buena Vista-Bethel SUD (net of Groundwater)	673	673	898	1,299	2,245	3,280
Ellis County Other	745	762	815	1,036	1,257	1,850
Files Valley WSC (part)	0	57	61	66	73	79
Italy (part)	0	72	159	266	419	662
Maypearl (part)	117	135	145	143	143	143
Ellis Co. Manufacturing (28%)	2,242	2,242	2,242	2,242	2,242	2,242
Ellis Co. Steam Electric	0	0	2,116	4,129	4,484	4,484
Total Demands	**10,649**	**11,682**	**15,756**	**20,480**	**24,612**	**29,455**
Other Supplies (Limited by Howard Road Plant Capacity)	11,212	11,373	11,806	12,021	11,722	11,586
Conservation	136	222	325	468	670	963
Waxahachie Supply from ECWSP (minimum 2,500 ac-ft per year)	**2,500**	**2,500**	**3,625**	**7,991**	**12,220**	**16,906**
Total Supply from ECWSP	**17,895**	**22,304**	**28,458**	**38,780**	**51,595**	**74,659**

Other water management strategies to provide additional water for Ellis County include:

- Water user groups getting water from DWU will get additional DWU supplies.
- Some water user groups will develop additional supplies from the Woodbine aquifer.
- Grand Prairie will purchase water from Arlington, Midlothian and Mansfield as well as DWU.
- Johnson County SUD will purchase additional water from Mansfield and water from Grand Prairie.
- Additional raw water and direct reuse supplies will be developed for steam electric power.

Water management strategies for each Ellis County water user group are discussed below (in alphabetical order). Table 5D.148 shows the estimated capital costs for the Ellis County water management strategies not associated with the wholesale water providers, and Table 5D.149 is a summary of the costs by category. Table 5D.149 is followed by a summary for Ellis County.

Bardwell

Bardwell is a city of about 630 people in southern Ellis County. The city's water supply is groundwater that requires desalination (Woodbine aquifer), and the city has recently begun to water purchase from Rockett SUD. (This purchase began after the deadline for this Region C Plan to consider the supply as "currently available" so all of supply from Rockett is shown as a strategy in the table below.) Water management strategies for Bardwell are conservation and purchasing additional water from Rockett SUD. Table 5D.126 shows the projected population and demand, the current supplies, and the water management strategies for Bardwell.

Table 5D.126
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Bardwell

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**831**	**1,063**	**1,333**	**1,650**	**2,024**	**4,500**
Projected Water Demand						
Municipal Demand	71	86	105	129	158	348
Total Projected Demand	***71***	***86***	***105***	***129***	***158***	***348***
Currently Available Water Supplies						
Woodbine Aquifer and Desalination	47	42	37	32	28	28
Total Current Supplies	***47***	***42***	***37***	***32***	***28***	***28***
Need (Demand - Current Supply)	***24***	***44***	***68***	***97***	***130***	***320***
Water Management Strategies						
Water Conservation	1	1	1	2	3	7
Rockett SUD (TRWD)	23	43	67	95	127	313
Total Water Management Strategies	***24***	***44***	***68***	***97***	***130***	***320***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Brandon-Irene Water Supply Corporation

Brandon-Irene Water Supply Corporation serves about 2,400 people in Ellis, Hill and Navarro Counties. The majority of the WSC's service area is in Hill County in the Brazos G region, so the water supply plans would be covered in more detail in the Brazos G Regional Water Plan. Plans for Region C are covered under Navarro County in Section 5D.12.

Buena Vista-Bethel Special Utility District

Buena Vista-Bethel SUD provides water to about 4,000 people in central and western Ellis County. The SUD gets its water supply from groundwater (Trinity aquifer) and water purchased from TRWD (through Waxahachie). Water management strategies for Buena Vista-Bethel SUD are conservation and additional water from Waxahachie. The existing infrastructure from Waxahachie has sufficient capacity for the SUD's ultimate demand. Table 5D.127 shows the projected population and demand, the current supplies, and the water management strategies for Buena Vista-Bethel SUD.

Table 5D.127
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Buena Vista-Bethel Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,500**	**5,500**	**6,500**	**8,000**	**11,500**	**15,326**
Projected Water Demand						
Municipal Demand	1,249	1,509	1,772	2,173	3,119	4,154
Total Projected Demand	***1,249***	***1,509***	***1,772***	***2,173***	***3,119***	***4,154***
Currently Available Water Supplies						
Trinity Aquifer	874	874	874	874	874	874
Waxahachie (TRWD)	170	142	143	376	620	728
Waxahachie (Lake Bardwell)	279	244	255	286	389	458
Waxahachie (Lake Waxahachie)	181	157	166	187	257	292
Waxahachie (Reuse)	225	227	295	386	554	659
Total Current Supplies	***1,728***	***1,644***	***1,732***	***2,109***	***2,693***	***3,012***
Need (Demand - Current Supply)	***0***	***0***	***40***	***64***	***426***	***1,142***
Water Management Strategies						
Water Conservation	23	39	53	72	114	166
Additional Waxahachie (TRWD)	0	0	0	0	312	976
Total Water Management Strategies	***23***	***39***	***53***	***72***	***426***	***1,142***
Reserve (Shortage)	**502**	**174**	**13**	**8**	**0**	**0**

Cedar Hill

The City of Cedar Hill has a population of about 45,000. It is located in southwest Dallas County, with a small part in Ellis County. The city's water supply plans are discussed under Dallas County in Section 5D.3.

Ellis County Irrigation

The water supplies for Ellis County Irrigation are local supplies and groundwater (Trinity and Woodbine aquifers). This supply is sufficient to meet demand, and there are no water management strategies. Table 5D.128 shows the projected demand, the current supplies, and the water management strategies for Ellis County Irrigation.

Table 5D.128
Projected Demand, Current Supplies,
and Water Management Strategies for Ellis County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**572**	**572**	**572**	**572**	**572**	**572**
Currently Available Water Supplies						
Local Supplies	3	3	3	3	3	3
Trinity Aquifer	129	129	129	129	129	129
Woodbine Aquifer	440	440	440	440	440	440
Total Current Supplies	***572***	***572***	***572***	***572***	***572***	***572***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Ellis County Livestock

The water supplies for Ellis County Livestock are local surface water supplies and groundwater (Woodbine aquifer). This supply is sufficient to meet demand, and there are no water management strategies. Table 5D.129 shows the projected demand, current supplies, and water management strategies for Ellis County Livestock.

Table 5D.129
Projected Demand, Current Supplies,
and Water Management Strategies for Ellis County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**905**	**905**	**905**	**905**	**905**	**905**
Currently Available Water Supplies						
Local Supplies	1,112	1,112	1,112	1,112	1,112	1,112
Woodbine Aquifer	97	97	97	97	97	97
Total Current Supplies	***1,209***	***1,209***	***1,209***	***1,209***	***1,209***	***1,209***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**304**	**304**	**304**	**304**	**304**	**304**

Ellis County Manufacturing

The water supplies for Ellis County Manufacturing are water purchased from Ennis, Midlothian, Waxahachie, and groundwater (Trinity and Woodbine aquifers). Water management strategies for Ellis County Manufacturing are conservation and additional water from Midlothian, Ennis, and Waxahachie. Table 5D.130 shows the projected demand, the current supplies, and the water management strategies for Ellis County Manufacturing.

Table 5D.130
Projected Demand, Current Supplies,
and Water Management Strategies for Ellis County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**5,247**	**5,403**	**5,560**	**5,716**	**5,716**	**5,716**
Currently Available Water Supplies						
Trinity Aquifer	900	900	900	900	900	900
Woodbine Aquifer	1,719	1,719	1,719	1,719	1,719	1,719
Midlothian (TRWD Sources)	164	143	119	103	89	79
Midlothian (Midlothian Sources)	94	67	52	43	35	29
Ennis (TRWD sources)	35	79	89	124	88	54
Ennis (Lake Bardwell)	490	460	366	263	160	95
Waxahachie (TRWD Sources)	565	472	356	649	619	498
Waxahachie (Lake Waxahachie)	602	524	413	323	257	200
Waxahachie (Lake Bardwell)	929	814	637	493	388	313
Waxahachie (Reuse)	749	755	736	666	553	450
Total Current Supplies	***6,248***	***5,933***	***5,388***	***5,282***	***4,808***	***4,338***
Need (Demand - Current Supply)	***0***	***0***	***172***	***434***	***908***	***1,378***
Water Management Strategies						
Water Conservation	0	6	63	88	90	90
Additional Water from Midlothian	4	60	107	140	162	178
Additional Water from Ennis	0	1	101	185	323	423
Additional Water from Waxahachie	0	0	99	111	425	781

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Total Water Management Strategies	***4***	***61***	***307***	***437***	***911***	***1,381***
Reserve (Shortage)	**1,005**	**592**	**135**	**3**	**3**	**3**

Ellis County Mining

The water supply for Ellis County Mining is groundwater (Woodbine aquifer). This supply is sufficient to meet demand, and there are no water management strategies. Table 5D.131 shows the projected demand, the current supplies, and the water management strategies for Ellis County Mining.

Table 5D.131
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Ellis County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**147**	**213**	**164**	**123**	**82**	**55**
Currently Available Water Supplies						
Woodbine Aquifer	213	213	213	213	213	213
Total Current Supplies	***213***	***213***	***213***	***213***	***213***	***213***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**66**	**0**	**49**	**90**	**131**	**158**

Ellis County Other

Ellis County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Ellis County Other supply about 6,000 people. This population is expected to increase to over 100,000 by 2070. The water supplies for Ellis County Other are water purchased from Rockett SUD, Waxahachie, Ennis, and groundwater (Trinity and Woodbine aquifers). Water management strategies for Ellis County Other are conservation, purchasing additional water from TRWD through various entities and additional groundwater (Woodbine aquifer). Table 5D.132 shows the projected population and demand, the current supplies, and the water management strategies for Ellis County Other.

Table 5D.132
Projected Demand, Current Supplies,
and Water Management Strategies for Ellis County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,100**	**6,500**	**7,177**	**27,642**	**60,016**	**105,596**
Projected Water Demand						
Municipal Demand	745	762	815	3,058	6,623	11,645
Total Projected Water Demand	***745***	***762***	***815***	***3,058***	***6,623***	***11,645***
Currently Available Water Supplies						
Rockett Special Utility District	481	333	224	162	142	186
Waxahachie (Lake Waxahachie)	200	178	150	149	144	165
Waxahachie (Lake Bardwell)	309	277	231	228	218	259
Waxahachie (Reuse)	249	257	268	308	310	372
Waxahachie (TRWD)	188	160	129	300	347	411
Ennis (Lake Bardwell)	172	161	134	351	464	486
Ennis (TRWD)	12	28	33	166	256	275
Trinity Aquifer	200	200	200	200	200	200
Woodbine Aquifer	345	345	345	345	345	345
Total Current Supplies	***2,156***	***1,939***	***1,715***	***2,209***	***2,425***	***2,697***
Need (Demand - Current Supply)	***0***	***0***	***0***	***849***	***4,198***	***8,948***
Water Management Strategies						
Water Conservation	6	9	8	41	110	233
Additional Water Rockett SUD	2,033	2,179	2,289	2,333	2,966	6,020
Additional Water Waxahachie	0	0	34	41	215	605
Additional Water Ennis	2	2	37	241	906	2,089
Total Water Management Strategies	***2,041***	***2,190***	***2,368***	***2,656***	***4,198***	***8,948***
Reserve (Shortage)	**3,452**	**3,367**	**3,268**	**1,807**	**0**	**0**

Ellis County Steam Electric Power

The water supplies for Ellis County Steam Electric Power are purchased from Ennis direct reuse, Ennis treated water, and Midlothian. Water management strategies for Ellis County Steam Electric Power are purchasing additional water from Midlothian, additional treated water from Ennis, treated water from Waxahachie, and a TRA direct reuse project. Table 5D.133 shows the projected demand, the current supplies, and the water management strategies for Ellis County Steam Electric Power. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.133
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Ellis County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**698**	**1,450**	**3,741**	**5,754**	**7,878**	**10,786**
Currently Available Water Supplies						
Ennis Direct Reuse	909	909	909	909	909	909
Ennis Treated Water	492	492	403	333	214	129
Midlothian	219	174	138	114	96	85
Total Current Supplies	***1,620***	***1,574***	***1,450***	***1,356***	***1,219***	***1,122***
Need (Demand - Current Supply)	***0***	***0***	***2,291***	***4,398***	***6,659***	***9,664***
Water Management Strategies						
Additional water from Midlothian	5	50	86	110	128	139
Additional Treated from Ennis	0	0	89	159	278	363
Waxahachie	0	0	2,116	4,129	4,484	4,484
Trinity River Authority Ellis Co. Reuse	0	0	0	0	2,200	4,700
Total Water Management Strategies	***5***	***51***	***2,291***	***4,398***	***7,090***	***9,687***
Reserve (Shortage)	**927**	**175**	**0**	**0**	**431**	**23**

Ennis

Ennis is a city of about 18,500 people located in southeastern Ellis County. The city is a wholesale water provider, and its water management strategies are discussed in Section 5C.2.

Ferris

Ferris is a city of about 2,440 people located in northern Ellis and southern Dallas Counties. Ferris gets it water supply from groundwater (Woodbine aquifer) and water purchased from Rockett SUD. Water management strategies for Ferris are conservation and purchasing additional water from Rockett SUD. Table 5D.134 shows the projected population and demand, the current supplies, and the water management strategies for Ferris.

Table 5D.134
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Ferris

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**2,946**	**3,550**	**4,174**	**4,844**	**8,022**	**15,026**
Projected Water Demand						
Municipal Demand	461	539	622	715	1,180	2,205
Total Projected Demand	***461***	***539***	***622***	***715***	***1,180***	***2,205***
Currently Available Water Supplies						
Woodbine Aquifer	353	353	353	353	353	353
Rockett SUD	76	104	121	138	252	413
Total Current Supplies	***429***	***457***	***474***	***491***	***605***	***766***
Need (Demand - Current Supply)	***32***	***82***	***148***	***224***	***575***	***1,439***
Water Management Strategies						
Water Conservation	4	6	6	10	20	44
Additional Rockett SUD (TRWD)	28	76	142	214	555	1,395
Increase delivery infrastructure from Rockett SUD in future	*0*	*0*	*0*	*0*	*394*	*1,395*
Total Water Management Strategies	***32***	***82***	***148***	***224***	***575***	***1,439***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Files Valley Water Supply Corporation

Files Valley WSC serves about 3,000 people in western Ellis and eastern Hill Counties. Files Valley provides water to residents in its service area as well as residents of Milford. The WSC purchases treated water from the Aquilla Water Supply District, which is located in Hill County and in the Brazos G region. Water management strategies for the WSC in Region C are conservation and purchasing water from Waxahachie (as part of the Ellis County Water Supply Project). Table 5D.135 shows the projected population and demand, the current supplies, and the water management strategies for Files Valley WSC in Region C. Information on Brazos G supplies can be found in the Brazos G Regional Water Plan.

Table 5D.135
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Files Valley Water Supply Corporation (Region C Only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Region C Population	**775**	**991**	**1,243**	**1,538**	**1,887**	**2,291**
Projected Water Demand						
Municipal Demand in Region C	119	148	182	223	272	330
Milford	66	67	69	74	80	89
Total Projected Region C Demand	***185***	***215***	***251***	***297***	***352***	***419***
Currently Available Water Supplies						
Aquilla Water Supply District (BRA - Region G)	119	148	182	223	272	330
Aquilla Water Supply District (BRA - Region G) for Milford	84	84	84	84	84	84
Total Current Supplies	***203***	***232***	***266***	***307***	***356***	***414***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***5***
Water Management Strategies						
Water Conservation	1	2	2	3	5	7
Ellis County Water Supply Project (Waxahachie from TRA from TRWD)	0	55	59	63	68	72
Total Water Management Strategies	***1***	***57***	***61***	***66***	***73***	***79***
Region C Reserve (Shortage)	**19**	**74**	**76**	**76**	**77**	**74**

Garrett

Garrett is a town of about 825 people located in eastern Ellis County. The water supplies for Garrett are water purchased from Community Water Company (which purchases water from Ennis) and water purchased directly from Ennis (sources are Ennis' Bardwell Supply and TRWD). Water management strategies for Garrett are conservation and purchasing additional water from Ennis. Table 5D.136 shows the projected demand, current supplies, and water management strategies for Garrett.

Table 5D.136
Projected Demand, Current Supplies, and Water Management Strategies for Garrett

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (In City Only)	**1,032**	**1,320**	**1,656**	**2,049**	**2,514**	**6,000**

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Municipal Demand	346	438	546	674	827	1,970
Total Projected Demand	***346***	***438***	***546***	***674***	***827***	***1,970***
Currently Available Water Supplies						
Ennis Bardwell Supply (via Community WC)	317	363	442	309	232	329
TRWD sources (via Ennis, via Community WC)	23	64	88	146	128	186
Total Current Supplies	***340***	***427***	***530***	***456***	***359***	***515***
Need (Demand - Current Supply)	***6***	***11***	***16***	***218***	***468***	***1,455***
Water Management Strategies						
Water Conservation	6	11	16	22	30	79
Add'l Ennis (TRWD, direct & via Community WC)	0	0	0	196	438	1,376
Total Water Management Strategies	***6***	***11***	***16***	***218***	***468***	***1,455***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Glenn Heights

Glenn Heights is a city of about 11,280 people located in southern Dallas and northern Ellis Counties. The city's water supply plans are discussed under Dallas County in Section 5D.3.

Grand Prairie

Grand Prairie is a city of about 175,400 in western Dallas County, eastern Tarrant County, and northwestern Ellis County. The city is a wholesale water provider, and there is a discussion of Grand Prairie's water supply plans in Section 5C.2.

Italy

Italy is located in southwest Ellis County and has a population of about 1,900. The water supplies for the city are from groundwater (Trinity and Woodbine aquifers). Water management strategies are conservation and connecting to and purchasing water from Waxahachie. Table 5D.137 shows the projected population and demand, the current supplies, and the water management strategies for Italy.

Table 5D.137
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Italy

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,386**	**3,052**	**3,828**	**4,738**	**6,000**	**8,000**
Projected Water Demand						
Municipal Demand	314	386	473	580	733	976
Total Projected Demand	***314***	***386***	***473***	***580***	***733***	***976***
Currently Available Water Supplies						
Trinity Aquifer	192	192	192	192	192	192
Woodbine Aquifer	122	122	122	122	122	122
Total Current Supplies	***314***	***314***	***314***	***314***	***314***	***314***
Need (Demand - Current Supply)	***0***	***72***	***159***	***266***	***419***	***662***
Water Management Strategies						
Water Conservation	3	4	5	8	12	20
Waxahachie (TRWD through TRA)	0	68	154	258	407	642
Total Water Management Strategies	***3***	***72***	***159***	***266***	***419***	***662***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Johnson County Special Utility District

The Johnson County Special Utility District has a large service area in Johnson and Hill Counties in the Brazos G region and Tarrant and Ellis Counties in Region C. The majority of the population served by the SUD is in Johnson County, and the Brazos G Regional Water Plan deals with the SUD's overall water supply strategies. The current supplies for Johnson County SUD are Mansfield (in Region C) and Brazos Regional Public Utility Agency SWATS (using water purchased from BRA) (in Region G). The SUD plans to purchase water from Grand Prairie (in Region C) in the future. These supplies originating in Region C will more than meet the demand for the SUD in Region C and leave considerable excess supplies for use in the Brazos G region. Water management strategies for Johnson County SUD are conservation, additional water from Mansfield, and connecting to Grand Prairie. Table 5D.138 shows the projected population and demand, the current supplies, and the water management strategies for Johnson County SUD in both Regions C and G.

Table 5D.138
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Johnson County Special Utility District (Region C & G)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**39,845**	**45,919**	**52,179**	**59,015**	**66,375**	**74,235**
Projected Water Demand						
Municipal Demand	5,134	5,735	6,389	7,155	8,027	8,970
Total Projected Region C Demand	***5,134***	***5,735***	***6,389***	***7,155***	***8,027***	***8,970***
Currently Available Water Supplies						
Mansfield (TRWD)	6,887	6,304	5,633	4,720	4,262	3,860
SWATS (BRA)	276	304	334	368	405	444
Total Current Supplies	***7,163***	***6,608***	***5,967***	***5,088***	***4,667***	***4,304***
Need (Demand - Current Supply)	***0***	***0***	***422***	***2,067***	***3,360***	***4,666***
Water Management Strategies						
Water Conservation	2	4	4	5	7	10
Additional Supply from Mansfield	3,202	3,785	4,456	5,369	5,827	6,229
Grand Prairie (multiple sources)	6,726	6,726	6,726	6,726	6,726	6,726
Total Water Management Strategies	***9,930***	***10,515***	***11,186***	***12,100***	***12,560***	***12,965***
Available for Brazos G Region	**11,959**	**11,388**	**10,764**	**10,033**	**9,200**	**8,299**

Mansfield

The City of Mansfield has a population of about 56,370 people in Ellis, Johnson and Tarrant Counties. Mansfield is a wholesale water provider, and there is a discussion of the city's water supply plans in Section 5C.2.

Maypearl

Maypearl is a city of about 955 located in western Ellis County. The city's water supplies are groundwater (Trinity and Woodbine aquifers). Water management strategies for Maypearl are conservation and purchasing treated water from Waxahachie (as part of the Ellis County Water Supply Project). Table 5D.139 shows the projected population and demand, the current supplies, and the water management strategies for Maypearl.

Table 5D.139
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Maypearl

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,128**	**1,359**	**1,500**	**1,500**	**1,500**	**1,500**
Projected Water Demand						
Municipal Demand	117	135	145	143	143	143
Total Projected Demand	***117***	***135***	***145***	***143***	***143***	***143***
Currently Available Water Supplies						
Trinity Aquifer	55	55	55	55	55	55
Woodbine Aquifer	100	100	100	100	100	100
Total Current Supplies	***155***	***155***	***155***	***155***	***155***	***155***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	2	2	3
Connect to Waxahachie (TRWD)	116	134	144	141	141	140
Total Water Management Strategies	***117***	***135***	***145***	***143***	***143***	***143***
Reserve (Shortage)	**155**	**155**	**155**	**155**	**155**	**155**

Midlothian

The City of Midlothian has a population of about 18,040 people in northwestern Ellis County. Midlothian is a wholesale water provider, and there is a discussion of the city's water supply plans in Section 5C.2.

Milford

Milford is a city of about 740 in southwest Ellis County. The city's water supplies are groundwater (Woodbine aquifer) and water purchased from Files Valley WSC (from Lake Aquilla/Brazos River Authority in Region G). The supply from Files Valley WSC is sufficient to meet the future demand and the only water management strategy for Milford is conservation. Table 5D.140 shows the projected population and demand, the current supplies, and the water management strategies for Milford.

Table 5D.140
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Milford

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**775**	**835**	**905**	**987**	**1,083**	**1,195**

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Municipal Demand	66	67	69	74	80	89
Total Projected Demand	***66***	***67***	***69***	***74***	***80***	***89***
Currently Available Water Supplies						
Woodbine Aquifer	32	32	32	32	32	32
Files Valley Water Supply Corporation (BRA in Region G)	84	84	84	84	84	84
Total Current Supplies	***116***	***116***	***116***	***116***	***116***	***116***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	1	1	2
Total Water Management Strategies	***1***	***1***	***1***	***1***	***1***	***2***
Reserve (Shortage)	**51**	**50**	**48**	**43**	**37**	**29**

Mountain Peak Special Utility District

Mountain Peak SUD serves customers in western Ellis County and eastern Johnson County. Water supplies for this SUD in Region C are groundwater (Trinity aquifer) and purchased water from Midlothian. (Supply from Region G will meet the demands of the Region G portion of this WUG.) Water management strategies in Region C include conservation, purchasing additional water from Midlothian, and additional groundwater (new wells in Woodbine aquifer). Table 5D.141 shows the projected population and demand, the current supplies, and the water management strategies for Mountain Peak SUD in Region C.

Table 5D.141
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Mountain Peak Special Utility District (Region C Only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**7,272**	**9,183**	**11,355**	**13,866**	**16,782**	**20,116**
Projected Water Demand						
Municipal Demand	1,671	2,109	2,627	3,240	3,971	4,820
Total Projected Demand	***1,671***	***2,109***	***2,627***	***3,240***	***3,971***	***4,820***
Currently Available Water Supplies						
Trinity Aquifer	1,257	1,257	1,257	1,257	1,257	1,257
Midlothian	1,381	1,572	1,707	1,833	1,963	2,104

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***2,638***	***2,829***	***2,964***	***3,090***	***3,220***	***3,361***
Need (Demand - Current Supply)	***0***	***0***	***0***	***150***	***751***	***1,459***
Water Management Strategies						
Water Conservation	14	22	26	191	551	709
Additional Water from Midlothian	0	0	0	0	200	750
Woodbine Aquifer (3 new wells)	7	7	7	7	7	7
Total Water Management Strategies	***21***	***29***	***33***	***198***	***758***	***1,466***
Reserve (Shortage)	**988**	**749**	**370**	**48**	**7**	**7**

Oak Leaf

Oak Leaf is a city of about 1,300 located in northern Ellis County. The city's water supply is water purchased from Glenn Heights (which purchases water from DWU), and some residents are provided retail service by Rockett SUD. Water management strategies for Oak Leaf are conservation and purchasing additional water from Glenn Heights and Rockett SUD. Table 5D.142 shows the projected population and demand, the current supplies, and the water management strategies for Oak Leaf.

Table 5D.142
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Oak Leaf

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,350**	**1,500**	**1,750**	**2,500**	**3,700**	**4,500**
Projected Water Demand						
Municipal Demand	155	165	186	262	385	468
Total Projected Demand	***155***	***165***	***186***	***262***	***385***	***468***
Currently Available Water Supplies						
Glenn Heights (DWU)	95	95	101	148	220	263
Rockett Special Utility District (TRWD and Midlothian)	39	30	25	21	16	13
Total Current Supplies	***134***	***125***	***126***	***169***	***236***	***276***
Need (Demand - Current Supply)	***21***	***40***	***60***	***93***	***149***	***192***
Water Management Strategies						
Water Conservation	1	2	2	3	6	9
Additional Glenn Heights (DWU)	4	13	28	56	104	141

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Rockett SUD (TRWD)	16	25	30	34	39	42
Total Water Management Strategies	***21***	***40***	***60***	***93***	***149***	***192***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Ovilla

Ovilla is a city of about 3,500 located in northern Ellis County and southern Dallas County. The city's water is water purchased from DWU. Water management strategies are conservation, purchasing additional water from DWU, and increasing delivery infrastructure from DWU. Table 5D.143 shows the projected population and demand, the current supplies, and the water management strategies for Ovilla.

Table 5D.143
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Ovilla

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,525**	**5,791**	**7,249**	**8,946**	**10,917**	**20,000**
Projected Water Demand						
Municipal Demand	1,080	1,357	1,682	2,067	2,519	4,610
Total Projected Demand	***1,080***	***1,357***	***1,682***	***2,067***	***2,519***	***4,610***
Currently Available Water Supplies						
Dallas Water Utilities	1,030	1,177	1,303	1,476	1,682	2,932
Total Current Supplies	***1,030***	***1,177***	***1,303***	***1,476***	***1,682***	***2,932***
Need (Demand - Current Supply)	***50***	***180***	***379***	***591***	***837***	***1,678***
Water Management Strategies						
Water Conservation	20	35	50	69	92	184
Additional Water from DWU	30	145	329	522	745	1,494
Increase delivery infrastructure from DWU	*0*	*0*	*0*	*0*	*0*	*1,494*
Total Water Management Strategies	***50***	***180***	***379***	***591***	***837***	***1,678***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Palmer

Palmer has a population of about 2,000 and is located in northeastern Ellis County. The city's water supplies are groundwater (Woodbine aquifer) and water purchased from Rockett SUD. Water management strategies for Palmer are conservation and purchasing water from Rockett SUD, including an increase in delivery infrastructure from Rockett SUD. Table 5D.144 shows the projected population and demand, the current supplies, and the water management strategies for Palmer.

Table 5D.144
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Palmer

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,562**	**3,276**	**4,109**	**5,086**	**6,500**	**12,000**
Projected Water Demand						
Municipal Demand	289	353	432	529	675	1,242
Total Projected Demand	***289***	***353***	***432***	***529***	***675***	***1,242***
Currently Available Water Supplies						
Rockett Special Utility District (TRWD & Midlothian)	201	198	194	201	205	277
Woodbine Aquifer	24	24	24	24	24	24
Total Current Supplies	***225***	***222***	***218***	***225***	***229***	***301***
Need (Demand - Current Supply)	***64***	***131***	***214***	***304***	***446***	***941***
Water Management Strategies						
Water Conservation	2	4	4	7	11	25
Additional Water from Rockett SUD	86	151	234	321	459	940
Increase delivery infrastructure from Rockett SUD	*10*	*72*	*151*	*245*	*387*	*940*
Total Water Management Strategies	***88***	***155***	***238***	***328***	***470***	***965***
Reserve (Shortage)	**24**	**24**	**24**	**24**	**24**	**24**

Pecan Hill

Pecan Hill has a population of about 640 and is located in northern Ellis County. The city's residents get retail water service from Rockett SUD, and that supply is expected to continue. Water management strategies for Pecan Hill are conservation and purchasing additional water from Rockett SUD. Table 5D.145 shows the projected population and demand, the current supplies, and the water management strategies for Pecan Hill.

Table 5D.145
Projected Population and Demand, Current Supplies, and
Water Management Strategies for the City of Pecan Hill

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**801**	**1,025**	**1,286**	**1,592**	**2,000**	**3,000**
Projected Water Demand						
Municipal Demand	***111***	***136***	***167***	***205***	***257***	***384***
Total Projected Demand						
Currently Available Water Supplies						
Rockett SUD (TRWD and Midlothian)	77	76	75	78	79	86
Total Current Supplies	***77***	***76***	***75***	***78***	***79***	***86***
Need (Demand - Current Supply)	***34***	***60***	***92***	***127***	***178***	***298***
Water Management Strategies						
Water Conservation	1	1	2	3	4	8
Additional Rockett SUD (TRWD)	33	59	90	124	174	290
Total Water Management Strategies	***34***	***60***	***92***	***127***	***178***	***298***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Red Oak

Red Oak is a city of about 10,770 people located in northern Ellis County. The city's water supplies are groundwater (Woodbine aquifer), purchasing water from DWU, and retail service for some residents from Rockett SUD. Water management strategies for Red Oak include conservation and purchasing additional water from DWU and Rockett SUD. Table 5D.146 shows the projected population and demand, the current supplies, and the water management strategies for Red Oak.

Table 5D.146
Projected Population and Demand, Current Supplies, and
Water Management Strategies for the City of Red Oak

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**12,369**	**14,000**	**19,000**	**26,000**	**32,000**	**50,000**
Projected Water Demand						
Municipal Demand	1,845	2,052	2,750	3,741	4,595	7,170
Total Projected Demand	***1,845***	***2,052***	***2,750***	***3,741***	***4,595***	***7,170***
Currently Available Water Supplies						
Woodbine Aquifer	556	556	556	556	556	556
Dallas Water Utilities	56	231	747	1,396	1,876	3,425

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Rockett Special Utility District	856	688	552	468	374	275
Total Current Supplies	***1,468***	***1,475***	***1,855***	***2,420***	***2,806***	***4,256***
Need (Demand - Current Supply)	***377***	***577***	***895***	***1,321***	***1,789***	***2,914***
Water Management Strategies						
Water Conservation	15	23	28	50	77	143
Additional Rockett SUD (TRWD)	364	527	659	729	805	860
Additional DWU	0	27	208	542	907	1,911
Total Water Management Strategies	***379***	***577***	***895***	***1,321***	***1,789***	***2,914***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

Rice Water Supply Corporation

Rice WSC provides retail service to about 5,570 people in northern Navarro County and southeastern Ellis County in and around the City of Rice. The WSC's water supply plans are discussed under Navarro County in Section 5D.12.

Rockett Special Utility District

Rockett SUD serves retail and wholesale customers in northern Ellis County and southern Dallas County. The SUD serves about 23,000 people outside of incorporated areas and has many more customers in cities. Rockett SUD is a wholesale water provider, and its water supply plans are discussed in Section 5C.2.

Sardis-Lone Elm Water Supply Corporation

Sardis-Lone Elm WSC is located in northern Ellis County with a small area in southern Dallas County. The WSC serves about 11,800 people outside of incorporated areas and also has some retail customers in Midlothian. The WSC currently gets all of its water supply from the Trinity aquifer, Woodbine aquifer, and Rockett SUD (TRWD and Midlothian). Water management strategies include conservation, additional supply from Rockett SUD (including increase in delivery infrastructure), and connecting to and purchasing from Midlothian. Table 5D.147 shows the projected population and demand, the current supplies, and the water management strategies for Sardis-Lone Elm WSC.

Table 5D.147
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Sardis-Lone Elm Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**14,500**	**18,000**	**22,000**	**24,000**	**25,340**	**25,340**
Projected Water Demand						
Municipal Demand	3,904	4,793	5,824	6,338	6,688	6,686
Total Projected Demand	***3,904***	***4,793***	***5,824***	***6,338***	***6,688***	***6,686***
Currently Available Water Supplies						
Trinity Aquifer	352	352	352	352	352	352
Woodbine Aquifer	1,386	1,386	1,386	1,386	1,386	1,386
Rockett Special Utility District (TRWD and Midlothian)	1,508	1,525	1,484	1,417	1,343	1,105
Total Current Supplies	***3,246***	***3,263***	***3,222***	***3,155***	***3,081***	***2,843***
Need (Demand - Current Supply)	***658***	***1,530***	***2,602***	***3,183***	***3,607***	***3,843***
Water Management Strategies						
Water Conservation	72	123	175	211	245	267
Rockett Special Utility District (TRWD)	586	1,407	2,427	2,972	3,362	3,576
Increase delivery Infrastructure from Rockett SUD	*0*	*0*	*548*	*1,026*	*1,342*	*1,318*
Connect to Midlothian (TRWD)	1,121	1,121	1,121	1,121	1,121	1,121
Total Water Management Strategies	***1,779***	***2,651***	***3,723***	***4,304***	***4,728***	***4,964***
Reserve (Shortage)	**1,121**	**1,121**	**1,121**	**1,121**	**1,121**	**1,121**

Waxahachie

Waxahachie is a city of about 29,621 people located in central Ellis County. The city is a wholesale water provider, and its water management strategies are discussed in Section 5C.2.

Venus

Venus is a city of about 2,960 people in eastern Johnson County and western Ellis County. Most of the population is in Johnson County which is in Region G. The city's water supplies are groundwater (Woodbine aquifer from Region G) and water purchased from Midlothian. Water management strategies for Venus are conservation and purchasing additional water from Midlothian. Table 5D.148 shows the projected population and demand, the current supplies, and the water management strategies for the City of Venus.

Table 5D.148
Projected Population and Demand, Current Supplies, and Water Management Strategies for City of Venus (Regions C and G)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,418**	**3,954**	**4,510**	**5,122**	**5,785**	**6,499**
Projected Water Demand						
Municipal Demand	640	730	826	935	1,053	1,182
Total Projected Demand	***640***	***730***	***826***	***935***	***1,053***	***1,182***
Currently Available Water Supplies						
Woodbine Aquifer (Region G)	211	211	211	211	211	211
Midlothian	269	275	263	260	261	268
Total Current Supplies	***480***	***486***	***474***	***471***	***472***	***479***
Need (Demand - Current Supply)	***160***	***244***	***352***	***464***	***581***	***703***
Water Management Strategies						
Water Conservation	0	1	1	1	1	2
Additional Midlothian (TRWD)	160	243	351	463	580	701
Total Water Management Strategies	***160***	***244***	***352***	***464***	***581***	***703***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Costs for Ellis County Water User Groups

Table 5D.149 shows the estimated capital costs for Ellis County water management strategies not covered under the wholesale water providers, and Table 5D.150 summarizes the costs by category. Table 5D.150 is followed by a summary for Ellis County.

Table 5D.149
Costs for Recommended Water Management Strategies for Ellis County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Bardwell	Conservation	2020	7	$1,157	$0.30	$0.00	Q-10
	Rockett SUD	2020	313	$0	$2.50	$2.50	None
Brandon-Irene WSC* (Region C only)	Conservation	See Navarro County.					
	Additional Aquilla WSC	See Navarro County.					

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Buena Vista-Bethel SUD	Conservation	2020	166	$58,210	$2.16	$0.74	Q-10
	Additional Waxahachie supplies	2020	976	$0	$2.50	$2.50	None
Cedar Hill*	Conservation	See Dallas County.					
	Additional DWU supplies	See Dallas County.					
Ellis County Other	Conservation	2020	233	$15,199	$0.65	$0.00	Q-10
	Ennis (TRWD through TRA - Ellis County Project)	2020	2,089	$0	$2.50	$2.50	None
	Additional Waxahachie (TRWD through TRA - Ellis County Project)	2020	605	$0	$3.45	$3.45	None
	Additional Rockett SUD (TRWD through TRA - Ellis County Project)	2020	6,020	$0	$3.75	$3.75	None
Ennis	Conservation	2020	2,029	$119,838	$3.26	$0.88	Q-10
	Other Measures	See Ennis in Section 5C.2.					
Ferris	Conservation	2020	44	$42,703	$2.74	$0.00	Q-10
	Additional Rocket SUD	2020	1,395	$0	$3.75	$3.75	None
	Increase delivery infrastructure from Rockett SUD in future	*2060*	*1,395*	$2,578,000	$0.62	$0.14	Q-109
Files Valley WSC	Conservation	2020	7	$2,010	$0.52	$0.00	Q-10
	Connect to Waxahachie (TRWD through TRA)	2030	72	See Waxahachie in Section 5C.2			
Garrett	Conservation	2020	79	$9,298	$1.98	$0.65	Q-10
	Additional TRWD Supply (via Ennis via Community Water Company)	2020	1,376	$0	$2.50	$2.50	None
Glenn Heights*	Conservation	See Dallas County.					
	Additional DWU supplies	See Dallas County.					

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Grand Prairie*	Conservation	See Dallas County.					
	Other Measures	See Grand Prairie in Section 5C.					
Italy	Conservation	2020	20	$6,406	$0.55	$0.00	Q-10
	Waxahachie	2020	642	$0	$3.45	$3.45	None
Johnson County SUD*	Conservation	See Tarrant County.					
	Additional Mansfield (TRWD)	See Tarrant County.					
	Grand Prairie	See Tarrant County.					
Mansfield*	Conservation	See Tarrant County.					
	Other Measures	See Mansfield in Section 5C.2.					
Maypearl	Conservation	2020	3	$2,030	$0.52	$0.00	Q-10
	Waxahachie from TRWD through TRA (Ellis County Project)	2020	144	$0	$3.45	$3.45	None
Midlothian	Conservation	2020	560	$531,705	$3.32	$0.73	Q-10
	Other Measures	See Midlothian in Section 5C.2.					
Milford	Conservation	2020	2	$4,460	$1.15	$0.00	Q-10
Mountain Peak SUD*	Conservation	2020	709	$43,492	$0.66	$0.47	Q-10
	Additional wells (Woodbine)	2020	7	$1,812,605	$2.23	$0.45	Q-112
	Additional Midlothian (TRWD through TRA)	2020	750	$0	$2.50	$2.50	None
Oak Leaf	Conservation	2020	9	$3,857	$0.99	$0.00	Q-10
	Additional Rockett SUD	2020	42	$0	$3.75	$3.75	None
	Additional Glenn Heights (DWU)	2020	141	$0	$2.50	$2.50	None
Ovilla*	Conservation	2020	184	$40,424	$2.45	$0.85	Q-10
	Additional DWU supplies	2020	1,494	$0	$1.48	$1.48	None
	Increase delivery infrastructure from DWU	*2070*	*1,494*	$8,136,000	$1.76	$0.36	Q-92

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Palmer	Conservation	2020	25	$30,952	$3.97	$0.00	Q-10
	Additional Rockett SUD	2020	940	$0	$3.75	$3.75	None
	Increase delivery infrastructure from Rockett SUD	*2020*	*940*	$6,628,000	$2.13	$0.32	Q-113
Pecan Hill	Conservation	2020	8	$2,168	$0.56	$0.00	Q-10
	Additional Rockett SUD	2020	290	$0	$3.75	$3.75	None
Red Oak	Conservation	2020	143	$63,535	$1.09	$0.00	Q-10
	Additional DWU supplies	2020	1,911	$0	$1.48	$1.48	None
	Additional Rockett SUD	2020	860	$0	$3.75	$3.75	None
Rice WSC*	Conservation	2020	40	$28,765	$1.06	$0.00	Q-10
	Additional Ennis	2020	37	$0	$2.50	$2.50	None
	Additional Corsicana	2040	1,121	$0	$3.25	$3.25	None
	Increase delivery infrastructure from Corsicana	*2040*	*1,038*	$6,983,000	$2.07	$0.35	Q-114
Rockett SUD*	Conservation	$2,020	236	$500,000	$4.01	$0.00	Q-10
	Other Measures	See Rockett SUD in Section 5C.					
Sardis-Lone Elm WSC	Conservation	2020	267	$111,552	$2.02	$0.72	Q-10
	Additional Rockett SUD	2020	3,576	$0	$3.75	$3.75	None
	Increase delivery Infrastructure from Rockett SUD	*2020*	*1,342*	$1,992,000	$0.42	$0.04	Q-118
	Midlothian Supplies	2020	1,121	$0	$2.50	$2.50	None
	Connect to Midlothian	*2020*	*1,121*	$255,200	$0.06	$0.01	Q-117
Venus*	Conservation	2020	2	$740	$0.00	$1.13	Q-10
	Additional Midlothian	2020	701	$0	$2.50	$2.50	None
Waxahachie	Conservation	2020	695	$1,500,000	$5.21	$0.80	Q-10
	Other Measures	See Waxahachie in Section 5C.					
Ellis County Irrigation	None	None					

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Ellis County Livestock	None	None					
Ellis County Manufacturing	Conservation	2030	90	$0	$0.95	$0.95	None
	Additional Ennis	2020	423	$0	$2.50	$2.50	None
	Additional Waxahachie	2030	781	$0	$3.45	$3.45	None
	Additional Midlothian	2030	178	$0	$2.50	$2.50	None
Ellis County Mining	None	None					
Ellis County Steam Electric	Waxahachie	2040	4,484	See Waxahachie in Section 5C.2			
	Additional Midlothian	2030	139	$0	$2.50	$2.50	None
	Additional Ennis	2020	363	$0	$2.50	$2.50	None
	TRA direct reuse	2060	4,700	See TRA in Section 5C.1			

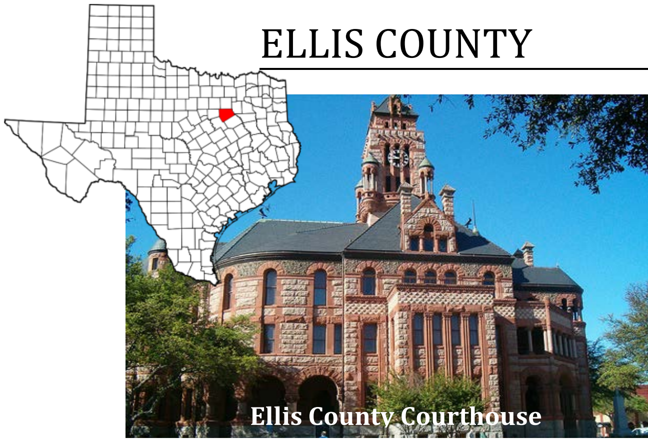
Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.150
Summary of Recommended Water Management Strategies for Ellis County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	5,558	$3,133,169
Purchase from WWP	32,843	$0
Purchase from WUG	141	$0
Delivery infrastructure	*7,330*	$26,572,200
Reuse	4,700	$0
Groundwater	7	$1,812,605
Total		**$31,517,974**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

ELLIS COUNTY



2010 Population: *149,610*

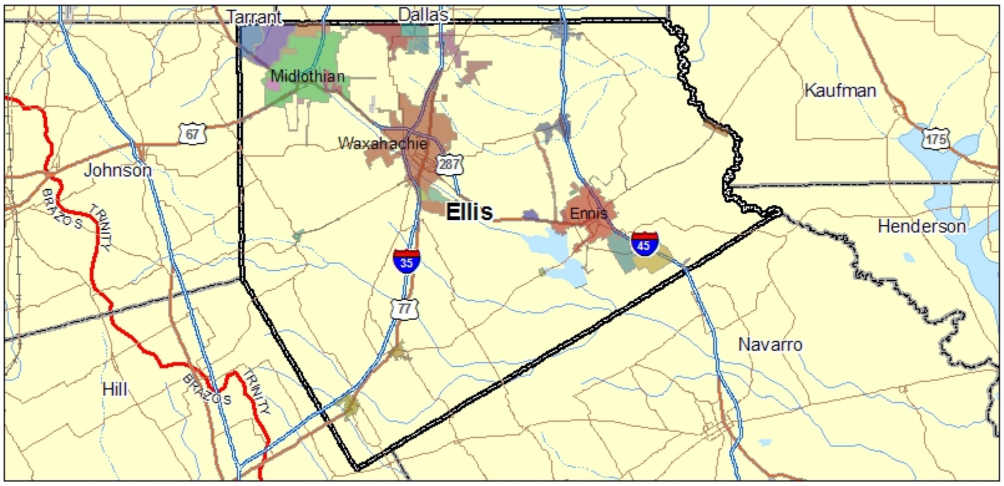
Projected 2070 Population: *683,974*

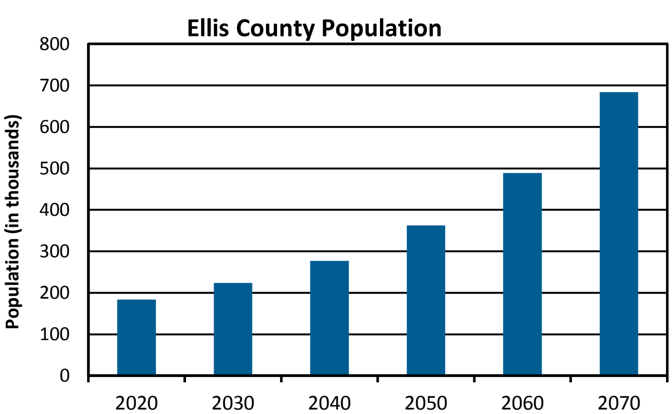
County Seat: *Waxahachie*

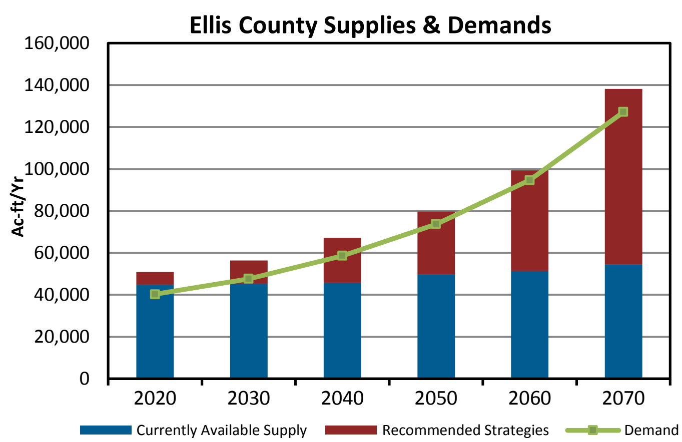
Economy: *Cement, steel production; warehousing and distribution; government/services*

River Basin(s):

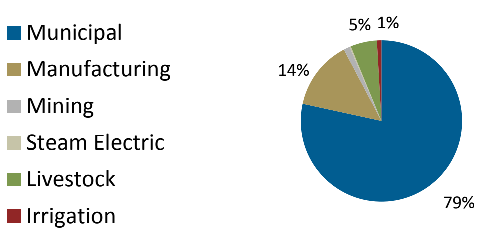
- Trinity (100%)





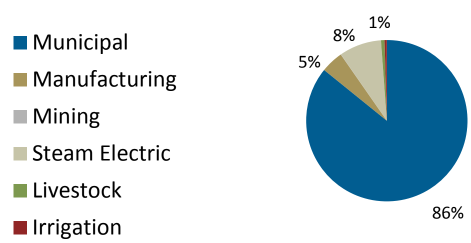


2010 Ellis County Historical Demand
(% of total)



Total=29,905 acre-feet

2070 Ellis County Projected Demand
(% of total)



Total= 127,173 acre-feet

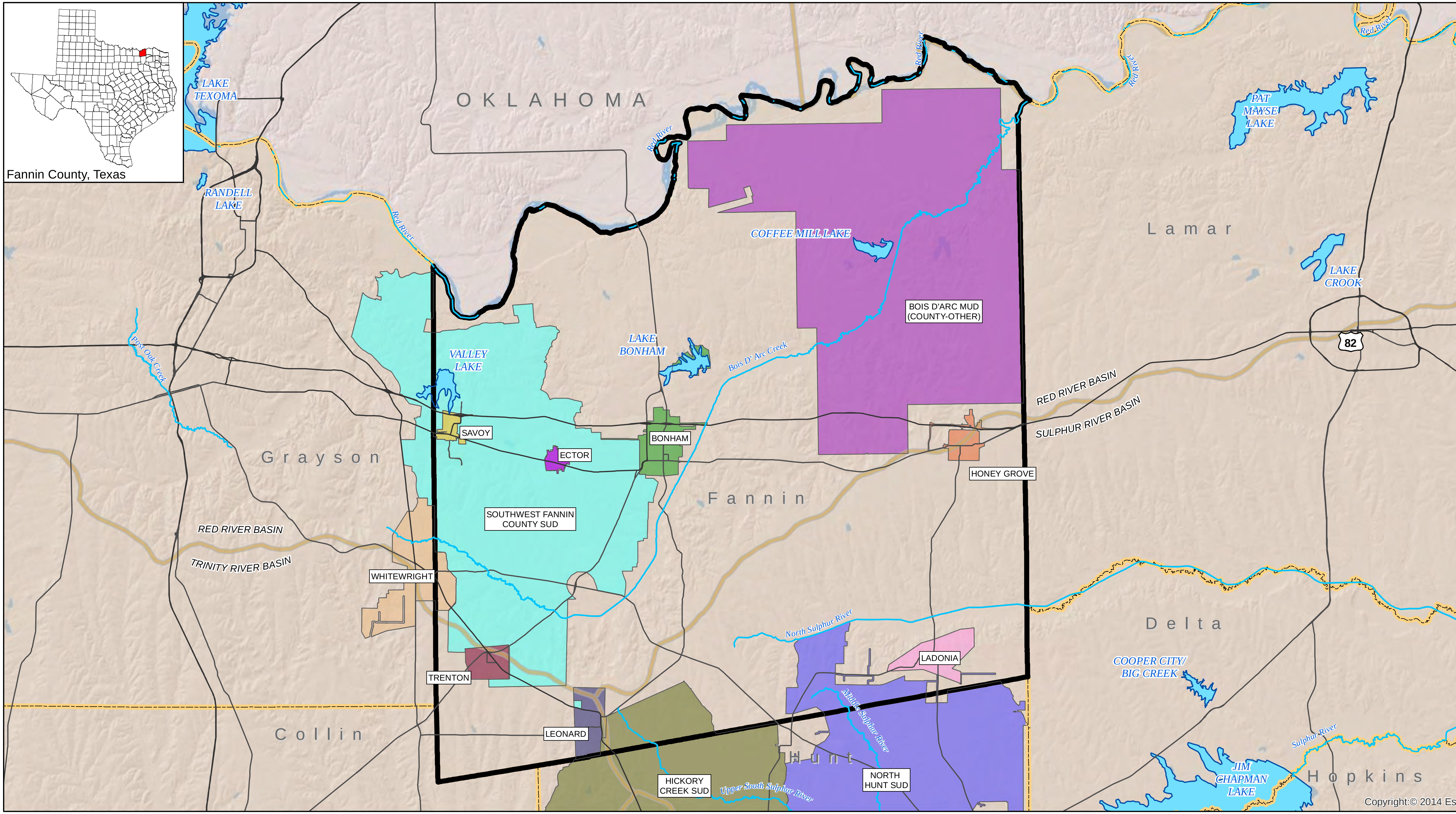
5D.6 Fannin County

Figure 5D.6 is a map of Fannin County. Fannin County is in the Red River Groundwater Conservation District. Most Fannin County water user groups use groundwater to meet their current needs. Bonham relies on Lake Bonham, and most of the county's current steam electric use is supplied from Lake Texoma (by diversions from the Red River to Valley Lake). There are also substantial run-of-the-river irrigation water rights from the Red River.

Current groundwater pumping from the Trinity aquifer in Fannin County exceeds the modeled available groundwater as determined by the Texas Water Development Board (TWBD). The modeled available groundwater in the Trinity aquifer is 700 acre-feet per year, and 2011 pumping from the Trinity was 2,015 acre-feet per year. As required by TWDB, this plan calls for the development of other sources of supply to eliminate the need for pumping from the aquifer beyond the modeled available groundwater volume. It is unclear if any entities will in fact decrease their pumping from the aquifer based on the recommendations in this plan. This plan calls for the use of other sources of supply (Woodbine and Other Aquifers and new surface water from Lower Bois d'Arc Creek Reservoir) to reduce use of the Trinity aquifer to the modeled available groundwater. The modeled available groundwater for the Woodbine aquifer in Fannin County is 3,297 acre-feet per year. According to TWDB records, the pumping from the Woodbine aquifer in Fannin County in 2011 was 2,420 acre-feet.

The North Texas Municipal Water District (NTMWD) plans to develop Lower Bois d'Arc Creek Reservoir in Fannin County by 2020. The Upper Trinity Regional Water District plans to develop Lake Ralph Hall by 2030. Both reservoirs will provide supplies for Fannin County as well as for other users in Region C.

NTMWD, the Greater Texoma Utility Authority (GTUA) and local suppliers in Fannin County have begun to develop the Fannin County Water Supply Project which will supply treated surface water (from Lower Bois d'Arc Creek Reservoir) to customers in Fannin County (Table 5D.151). Water for the Fannin County Water Supply Project will be delivered from NTMWD's planned surface water treatment plant in Fannin County near Leonard. This strategy will require treated water transmission facilities to deliver water to water user groups. The Fannin County Water Supply Project will be developed by a combination of NTMWD, GTUA, and suppliers in the county. For this plan, the capital costs ($45.8 million) are included under NTMWD in Section 5C.1.



FREESE AND NICHOLS

Project No: NTD11336

Service Area

County Boundary

Fannin County Boundary

River Basin Divide

Stream

Reservoir

N S E W

1 inch = 4.5 miles

0 2.25 4.5 9

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Fannin County, Texas

Figure 5D.6

Water management strategies for Fannin County water user groups are discussed below (in alphabetical order). Table 5D.168 shows the estimated capital costs for the Fannin County water management strategies not associated with the wholesale water providers, and Table 5D.169 is a summary of the costs by category. Table 5D.169 is followed by a summary for Fannin County.

Table 5D.151
Projected Supplies from the Fannin County Water Supply Project

Water User Group	Supplies from the Fannin Co. WSP (Ac-Ft/Yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Bonham	0	0	723	1,872	2,822	3,932
Ector	0	47	51	56	64	73
Fannin County Other	0	0	131	617	2,818	5,311
Honey Grove	0	188	244	241	241	241
Leonard	0	152	198	216	247	282
Savoy	0	32	44	48	56	65
Southwest Fannin Co. SUD	0	343	442	557	797	1,073
Trenton	0	93	523	955	1,301	1,647
Fannin County Manufacturing	0	1	24	48	64	80
Fannin County Mining	56	56	56	56	56	56
Total	**56**	**912**	**2,436**	**4,666**	**8,466**	**12,760**

Bonham

Bonham is a city of about 10,100 located in central Fannin County. The city uses raw water from Lake Bonham, which is treated by NTMWD. Bonham supplies several small water supply corporations included in Fannin County Other as well as some manufacturing in the city. Water management strategies for Bonham include conservation and participation in the Fannin County Water Supply Project. Table 5D.152 shows the projected population and demand, the current supplies, and the water management strategies for Bonham.

Table 5D.152
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Bonham

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**12,603**	**16,000**	**22,000**	**30,000**	**37,000**	**45,000**
Projected Water Demand						
Municipal Demand	2,024	2,506	3,393	4,598	5,663	6,883
Fannin County Manufacturing	88	97	106	114	124	135

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Fannin County Other	399	611	614	1,096	3,260	5,753
Total Projected Demand	***2,511***	***3,214***	***4,113***	***5,808***	***9,047***	***12,771***
Currently Available Water Supplies						
Lake Bonham (NTMWD) for Bonham	2,024	2,491	2,636	2,665	2,747	2,813
Lake Bonham (NTMWD) for Fannin Co Manufacturing	88	96	82	66	60	55
Lake Bonham (NTMWD) for Fannin Co Other	399	607	477	464	388	327
Total Current Supplies	***2,511***	***3,195***	***3,195***	***3,195***	***3,195***	***3,195***
Need (Demand - Current Supply)	***0***	***19***	***918***	***2,613***	***5,852***	***9,576***
Water Management Strategies						
Water Conservation - Bonham	35	27	34	61	94	138
Water Conservation - County Other	3	7	6	15	54	115
Fannin Co Water Supply Project-Bonham (NTWMD)	0	0	723	1,872	2,822	3,932
Fannin Co Water Supply Project-Fannin Co Manufacturing (NTWMD)	0	1	24	48	64	80
Fannin Co Water Supply Project-Fannin Co Other (NTWMD)	0	0	131	617	2,818	5,311
Total Water Management Strategies	***38***	***35***	***918***	***2,613***	***5,852***	***9,576***
Reserve (Shortage)	**38**	**16**	**0**	**0**	**0**	**0**

Ector

Ector has a population of about 700 and is located in western Fannin County. The city currently gets its water supplies from the Woodbine aquifer. Water management strategies for Ector include water conservation and participation in the Fannin County Water Supply Project. Table 5D.153 shows the projected population and demand, the current supplies, and the water management strategies for Ector.

Table 5D.153
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Ector

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**773**	**850**	**909**	**962**	**1,044**	**1,133**
Projected Water Demand						
Municipal Demand	87	92	96	101	109	118

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Projected Demand	***87***	***92***	***96***	***101***	***109***	***118***
Currently Available Water Supplies						
Woodbine Aquifer	87	87	87	87	87	87
Total Current Supplies	***87***	***87***	***87***	***87***	***87***	***87***
Need (Demand - Current Supply)	***0***	***5***	***9***	***14***	***22***	***31***
Water Management Strategies						
Water Conservation	1	1	1	1	2	2
NTNWD-Fannin Co Water Supply Project (NTWMD)	0	46	50	55	62	71
Total Water Management Strategies	***1***	***47***	***51***	***56***	***64***	***73***
Reserve (Shortage)	**1**	**42**	**42**	**42**	**42**	**42**

Fannin County Irrigation

Table 5D.154 shows the projected demand, the current supplies, and the water management strategies for Fannin County Irrigation. As shown in Table 5D.154, diversions from the Red River and groundwater from the Woodbine and other aquifer (the alluvium of the Red River) are available for irrigation use in Fannin County. It should be noted that these run-of-river supplies are available only along the Red River and are not suitable for municipal use without desalination or blending. These sources are sufficient to meet future demands, and there are no water management strategies needed for Fannin County Irrigation.

Table 5D.154
Projected and Demand, Current Supplies,
and Water Management Strategies for Fannin County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**8,301**	**8,301**	**8,301**	**8,301**	**8,301**	**8,301**
Currently Available Water Supplies						
Red River (Run-of-River)	4,613	4,613	4,613	4,613	4,613	4,613
Other Aquifer	2,909	2,909	2,909	2,909	2,909	2,909
Woodbine Aquifer	780	780	780	780	780	780
Total Current Supplies	***8,302***	***8,302***	***8,302***	***8,302***	***8,302***	***8,302***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**1**	**1**	**1**	**1**	**1**	**1**

Fannin County Livestock

Table 5D.155 shows the projected demand, current supplies, and water management strategies for Fannin County Livestock. The current supplies for Fannin County Livestock are local surface water supplies and groundwater (Trinity, Woodbine, and other aquifers). These sources are sufficient to meet future demands, and there are no water management strategies for this water user group.

Table 5D.155
Projected and Demand, Current Supplies,
and Water Management Strategies for Fannin County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,668**	**1,668**	**1,668**	**1,668**	**1,668**	**1,668**
Currently Available Water Supplies						
Local Supplies	1,306	1,306	1,306	1,306	1,306	1,306
Other Aquifer	10	10	10	10	10	10
Trinity Aquifer	320	320	320	320	320	320
Woodbine Aquifer	32	32	32	32	32	32
Total Current Supplies	***1,668***	***1,668***	***1,668***	***1,668***	***1,668***	***1,668***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fannin County Manufacturing

Table 5D.156 shows the projected demand, the current supplies, and the water management strategies for Fannin County Manufacturing. The current supply is water from Lake Bonham through the City of Bonham. The only water management strategy for this water user group is participation in the Fannin County Water Supply Project (through Bonham). Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5D.156
Projected and Demand, Current Supplies,
and Water Management Strategies for Fannin County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**88**	**97**	**106**	**114**	**124**	**135**
Currently Available Water Supplies						
NTMWD (Lake Bonham thru Bonham)	88	96	82	66	60	55
Total Current Supplies	***88***	***96***	***82***	***66***	***60***	***55***
Need (Demand - Current Supply)	***0***	***1***	***24***	***48***	***64***	***80***
Water Management Strategies						
Fannin County Water Supply Project (NTWMD)	0	1	24	48	64	80
Total Water Management Strategies	***0***	***1***	***24***	***48***	***64***	***80***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fannin County Mining

Table 5D.157 shows the projected demand, the current supplies, and the water management strategies for Fannin County Mining. Fannin County Mining is supplied from run-of-the river diversions. The recommended water management strategies for this water user group is participation in the Fannin County Water Supply Project. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5D.157
Projected and Demand, Current Supplies,
and Water Management Strategies for Fannin County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**128**	**128**	**128**	**128**	**128**	**128**
Currently Available Water Supplies						
Run-Of-River	72	72	72	72	72	72

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***72***	***72***	***72***	***72***	***72***	***72***
Need (Demand - Current Supply)	***56***	***56***	***56***	***56***	***56***	***56***
Water Management Strategies						
Fannin County Water Supply Project (NTWMD)	56	56	56	56	56	56
Total Water Management Strategies	***56***	***56***	***56***	***56***	***56***	***56***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fannin County Other

Fannin County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Fannin County Other supply about 12,000 people and receive their water supply from NTMWD (treated water from Lake Bonham purchased through the City of Bonham), run-of-the-river diversions from the Red and Sulphur Rivers, and groundwater (Trinity and Woodbine aquifers). Water management strategies for these entities include conservation, participation in the Fannin County Water Supply Project. Table 5D.158 shows the projected population and demand, the current supplies, and the water management strategies for Fannin County Other.

Table 5D.158
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Fannin County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**13,168**	**13,168**	**13,168**	**18,250**	**40,000**	**65,000**
Projected Water Demand						
Municipal Demand	1,466	1,411	1,364	1,846	4,010	6,503
Total Projected Water Demand	***1,466***	***1,411***	***1,364***	***1,846***	***4,010***	***6,503***
Currently Available Water Supplies						
NTMWD (Lake Bonham thru Bonham)	399	607	477	464	388	327
Run-of-river - Red River	20	20	20	20	20	20
Run-of-river - Sulphur River	49	49	49	49	49	49
Trinity Aquifer	260	260	260	260	260	260
Woodbine Aquifer	738	738	738	738	738	738
Total Current Supplies	***1,466***	***1,674***	***1,544***	***1,531***	***1,455***	***1,394***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***0***	***0***	***0***	***315***	***2,555***	***5,109***
Water Management Strategies						
Water Conservation	12	17	14	25	67	130
Fannin County Water Supply Project (NTWMD)	0	0	123	607	2,805	5,296
Total Water Management Strategies	***12***	***17***	***137***	***632***	***2,872***	***5,426***
Reserve (Shortage)	**12**	**280**	**317**	**317**	**317**	**317**

Fannin County Steam Electric Power

Table 5D.159 shows the projected demand, the current supplies, and the water management strategies for Fannin County Steam Electric Power. Fannin County Steam Electric Power is currently supplied by water from Lake Texoma (released into the Red River and diverted into Valley Lake) and groundwater from the Woodbine aquifer. The only water management strategy for this water user group is additional water from Lake Texoma through GTUA (as part of the Grayson County Water Supply Project, see table 5D.182 under Grayson County in Section 5D.8). Table 5D.159 shows the projected population and demand, the current supplies, and the water management strategies for Fannin County Steam Electric Power. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.159
Projected Current Supplies, and Water Management Strategies for Fannin County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**6,363**	**11,474**	**11,910**	**12,443**	**13,092**	**13,775**
Currently Available Water Supplies						
Lake Texoma (Luminant/Valley Lake)	6,363	6,363	6,363	6,363	6,363	6,363
Woodbine Aquifer	200	200	200	200	200	200
Total Current Supplies	***6,563***	***6,563***	***6,563***	***6,563***	***6,563***	***6,563***
Need (Demand - Current Supply)	***0***	***4,911***	***5,347***	***5,880***	***6,529***	***7,212***
Water Management Strategies						
Grayson County WSP (GTUA-Lake Texoma)	0	9,000	9,000	9,000	9,000	9,000
Total Water Management Strategies	***0***	***9,000***	***9,000***	***9,000***	***9,000***	***9,000***
Reserve (Shortage)	**200**	**4,089**	**3,653**	**3,120**	**2,471**	**1,788**

Hickory Creek Special Utility District

Hickory Creek SUD serves about 4,000 people in eastern Collin County, southern Fannin County, and northwestern Hunt County. The SUD is primarily located in Hunt County in the North East Texas Region (Region D), and the supply for Region C is groundwater from the Woodbine aquifer in Hunt County in the North East Texas Region. The only Region C water management strategy is conservation. Table 5D.160 shows the projected population and demand, the current supplies, and the water management strategies for Hickory Creek SUD in Region C. Plans for the North East Texas Region are covered in that regional water plan.

Table 5D.160
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Hickory Creek SUD (Region C Only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (Total)	**4,517**	**6,474**	**9,112**	**12,741**	**17,913**	**25,413**
Projected Water Demand						
Municipal Demand (Region C)	36	38	40	42	46	50
Total Projected Demand	***36***	***38***	***40***	***42***	***46***	***50***
Currently Available Water Supplies						
Woodbine Aquifer (in Region D)	50	50	50	50	50	50
Total Current Supplies	***50***	***50***	***50***	***50***	***50***	***50***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	0	1	1	1
Total Water Management Strategies	***0***	***0***	***0***	***1***	***1***	***1***
Reserve (Shortage)	**14**	**12**	**10**	**9**	**5**	**1**

Honey Grove

Honey Grove is a city of about 1,700 located in eastern Fannin County. The city currently gets its water supplies from the Woodbine aquifer. Water management strategies for Honey Grove include water conservation and participation in the Fannin County Water Supply Project. Table 5D.161 shows the projected population and demand, the current supplies, and the water management strategies for Honey Grove.

Table 5D.161
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Honey Grove

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,700**	**1,800**	**1,800**	**1,800**	**1,800**	**1,800**
Projected Water Demand						
Municipal Demand	274	280	274	271	271	271
Total Projected Demand	***274***	***280***	***274***	***271***	***271***	***271***
Currently Available Water Supplies						
Woodbine Aquifer	274	274	274	274	274	274
Total Current Supplies	***274***	***274***	***274***	***274***	***274***	***274***
Need (Demand - Current Supply)	***0***	***6***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	3	4	5	5
Fannin Co Water Supply Project (NTWMD)	0	185	241	237	236	236
Total Water Management Strategies	***2***	***188***	***244***	***241***	***241***	***241***
Reserve (Shortage)	**2**	**182**	**244**	**244**	**244**	**244**

Ladonia

Ladonia has a population of about 600 people and is located in southeastern Fannin County. The city gets its water from the Trinity aquifer, and water management strategies include conservation and purchasing raw water from Upper Trinity Regional Water District and treating it. Table 5D.162 shows the projected population and demand, the current supplies, and the water management strategies for Ladonia.

Table 5D.162
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Ladonia

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,600**	**2,000**	**2,200**	**2,500**	**3,000**	**3,000**
Projected Water Demand						
Municipal Demand	120	144	155	175	210	209
Total Projected Demand	***120***	***144***	***155***	***175***	***210***	***209***
Currently Available Water Supplies						
Trinity Aquifer	120	120	120	120	120	120

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***120***	***120***	***120***	***120***	***120***	***120***
Need (Demand - Current Supply)	***0***	***24***	***35***	***55***	***90***	***89***
Water Management Strategies						
Water Conservation	1	2	2	2	4	4
Upper Trinity Regional Water District (Ralph Hall Lake); Connect; WTP	0	34	57	89	134	133
Total Water Management Strategies	***1***	***36***	***59***	***91***	***138***	***137***
Reserve (Shortage)	**1**	**12**	**24**	**36**	**48**	**48**

Leonard

Leonard is located in southwestern Fannin County and has a population of about 2,000 people. The city gets its water from the Woodbine aquifer. Water management strategies for Leonard include conservation, participating in the Fannin County Water Supply Project, and water system improvements needed in order to take delivery of water from the Fannin County Water Supply Project. Table 5D.163 shows the projected population and demand, the current supplies, and the water management strategies for Leonard.

Table 5D.163
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Leonard

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,213**	**2,434**	**2,602**	**2,757**	**2,991**	**3,245**
Projected Water Demand						
Municipal Demand	331	352	368	386	417	452
Total Projected Demand	***331***	***352***	***368***	***386***	***417***	***452***
Currently Available Water Supplies						
Woodbine Aquifer	331	331	331	331	331	331
Total Current Supplies	***331***	***331***	***331***	***331***	***331***	***331***
Need (Demand - Current Supply)	***0***	***21***	***37***	***55***	***86***	***121***
Water Management Strategies						
Water Conservation	3	4	4	5	7	9

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Fannin Co Water Supply Project (NTWMD)	0	148	194	211	240	273
Water System Improvement needed to take delivery of water from Fannin Co WSP	*0*	*148*	*194*	*211*	*240*	*273*
Total Water Management Strategies	***3***	***152***	***198***	***216***	***247***	***282***
Reserve (Shortage)	**3**	**131**	**161**	**161**	**161**	**161**

North Hunt Water Supply Corporation

North Hunt WSC serves about 4,000 people in southern Fannin County in Region C and Delta and Hunt Counties in the North East Texas Region (Region D). The WSC is primarily located in the North East Texas Region (Region D). North Hunt WSC supply in Region C is groundwater from the Woodbine aquifer, and the only Region C water management strategy is conservation. Table 5D.164 shows the projected population and demand, the current supplies, and the water management strategy for the Region C portion of North Hunt WSC. Plans for the North East Texas Region portion of the WSC are covered in that regional water plan.

Table 5D.164
Projected Population and Demand, Current Supplies, and Water Management Strategies for the North Hunt Water Supply Corporation (Region C Only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population in Region C	**525**	**577**	**617**	**653**	**709**	**769**
Projected Water Demand - Region C						
Municipal Demand	36	39	42	44	48	52
Total Projected Demand in Region C	***36***	***39***	***42***	***44***	***48***	***52***
Currently Available Water Supplies						
Woodbine Aquifer	52	52	52	52	52	52
Total Current Supplies	***52***	***52***	***52***	***52***	***52***	***52***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	0	1	1	1
Total Water Management Strategies	***0***	***0***	***0***	***1***	***1***	***1***
Reserve (Shortage)	**16**	**13**	**10**	**9**	**5**	**1**

Savoy

Savoy is a city of about 850 located in western Fannin County. The city currently gets its water supplies from the Woodbine aquifer. Water management strategies for Savoy include water conservation and participation in the Fannin County Water Supply Project. Table 5D.165 shows the projected population and demand, the current supplies, and the water management strategies for Savoy.

Table 5D.165
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Savoy

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**924**	**1,016**	**1,086**	**1,151**	**1,249**	**1,355**
Projected Water Demand						
Municipal Demand	88	92	94	98	106	115
Total Projected Demand	***88***	***92***	***94***	***98***	***106***	***115***
Currently Available Water Supplies						
Woodbine Aquifer	88	88	88	88	88	88
Total Current Supplies	***88***	***88***	***88***	***88***	***88***	***88***
Need (Demand - Current Supply)	***0***	***4***	***6***	***10***	***18***	***27***
Water Management Strategies						
Water Conservation	1	1	1	1	2	2
Fannin County Water Supply Project (NTWMD)	0	31	43	47	54	63
Total Water Management Strategies	***1***	***32***	***44***	***48***	***56***	***65***
Reserve (Shortage)	**1**	**28**	**38**	**38**	**38**	**38**

Southwest Fannin County Special Utility District

Southwest Fannin County SUD serves about 5,000 people in western Fannin County and eastern Grayson County. The SUD's existing water supply comes from the Woodbine aquifer. Water management strategies for Southwest Fannin County SUD include water conservation, a new well in the Woodbine Aquifer (with associated transmission facilities), and participation in the Fannin County Water Supply Project. Table 5D.166 shows the projected population and demand, the current supplies, and the water management strategies for Southwest Fannin County SUD.

Table 5D.166
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Southwest Fannin County Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**5,628**	**6,913**	**8,096**	**9,384**	**12,000**	**15,000**
Projected Water Demand						
Municipal Demand	559	664	763	878	1,118	1,394
Total Projected Demand	***559***	***664***	***763***	***878***	***1,118***	***1,394***
Currently Available Water Supplies						
Woodbine Aquifer	610	610	610	610	610	610
Total Current Supplies	***610***	***610***	***610***	***610***	***610***	***610***
Need (Demand - Current Supply)	***0***	***54***	***153***	***268***	***508***	***784***
Water Management Strategies						
Water Conservation	5	7	8	12	19	28
New Well in Woodbine Aquifer and Transmission Facilities		100	100	100	100	100
Fannin County Water Supply Project	0	336	434	545	778	1,045
Total Water Management Strategies	***5***	***443***	***542***	***657***	***897***	***1,173***
Reserve (Shortage)	**56**	**389**	**389**	**389**	**389**	**389**

Trenton

Trenton is located in southwestern Fannin County and has a population of about 650 people. The city gets its water from the Woodbine aquifer. Water management strategies for Trenton include conservation, a new well in the Woodbine Aquifer, and participation in the Fannin County Water Supply Project. Table 5D.167 shows the projected population and demand, the current supplies, and the water management strategies for Trenton.

Table 5D.167
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Trenton

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**706**	**1,000**	**3,500**	**6,000**	**8,000**	**10,000**
Projected Water Demand						
Municipal Demand	131	179	609	1,041	1,387	1,733
Total Projected Demand	***131***	***179***	***609***	***1,041***	***1,387***	***1,733***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Currently Available Water Supplies						
Woodbine Aquifer	131	131	131	131	131	131
Total Current Supplies	***131***	***131***	***131***	***131***	***131***	***131***
Need (Demand - Current Supply)	***0***	***48***	***478***	***910***	***1,256***	***1,602***
Water Management Strategies						
Water Conservation	1	4	15	35	51	69
New Well in Woodbine Aquifer (Fannin Co)		25	25	25	25	25
Fannin Co Water Supply Project	0	89	508	920	1,250	1,578
Total Water Management Strategies	***1***	***118***	***548***	***980***	***1,326***	***1,672***
Reserve (Shortage)	**1**	**70**	**70**	**70**	**70**	**70**

Whitewright

Whitewright is a city of about 1,600 people located in eastern Grayson County with a small area in Fannin County. The city's water supply plans are discussed under Grayson County in Section 5D.8.

Costs for Fannin County Water User Groups

Table 5D.168 shows the estimated capital costs for Fannin County water management strategies not covered under the wholesale water providers, and Table 5D.169 summarizes the costs by category.

Table 5D.168
Costs for Recommended Water Management Strategies for Fannin County
Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Bonham	Conservation	2040	138	$98,964	$5.66	$0.00	Q-10
	Fannin County Water Supply Project	2020	3,932	See NTMWD in Section 5C.			
Ector	Conservation	2020	2	$5,171	$1.33	$0.00	Q-10
	Fannin County Water Supply Project	2030	31	See NTMWD in Section 5C.			

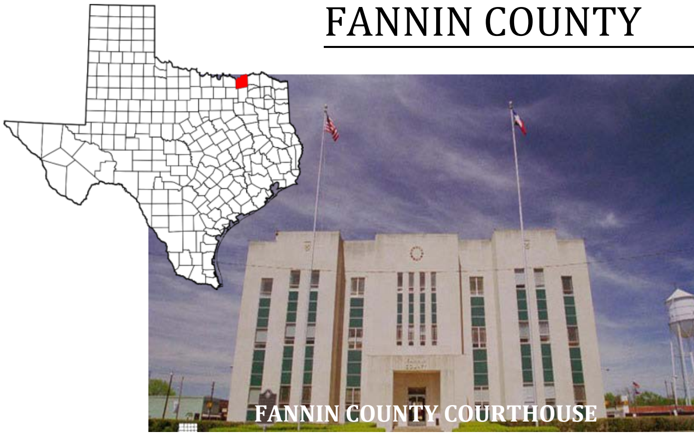
Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Fannin County Other	Conservation	2020	130	$29,907	$0.64	$0.00	Q-10
	Fannin County Water Supply Project	2050	5,296	See NTMWD in Section 5C.			
Hickory Creek SUD* (Region C portion only)	Conservation	2020	1	$555	$0.00	$0.00	Q-10
Honey Grove	Conservation	2020	5	$3,829	$0.49	$0.00	Q-10
	Fannin County Water Supply Project	2030	241	See NTMWD in Section 5C.			
Ladonia	Conservation	2020	4	$6,099	$1.57	$0.00	Q-10
	Lake Ralph Hall supply	2030	134	$12,134,600	$43.59	$20.34	Q-129
Leonard	Conservation	2020	9	$16,497	$1.41	$0.00	Q-10
	Fannin County Water Supply Project	2020	273	See NTMWD in Section 5C.			
	Water System Improvements	*2020*	*273*	$2,567,600	$3.54	$1.12	Q-207
North Hunt WSC*	Conservation	2020	1	See Region D Plan.			
Savoy	Conservation	2020	2	$1,433	$0.37	$0.00	Q-10
	Fannin County Water Supply Project	2030	63	See NTMWD in Section 5C.			
Southwest Fannin Co SUD*	Conservation	2020	28	$12,165	$0.62	$0.00	Q-10
	Additional Groundwater (with transmission facilities)	2030	100	$2,348,823	$7.85	$1.81	Q-130
	Fannin County Water Supply Project	2030	1,045	See NTMWD in Section 5C.			
Trenton	Conservation	2020	69	$6,658	$1.71	$1.22	Q-10
	New Wells in Woodbine Aquifer	2030	25	$971,785	$12.73	$2.79	Q-131
	Fannin County Water Supply Project	2030	1,578	See NTMWD in Section 5C.			

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Whitewright*	Conservation	See Grayson County.					
	Grayson County Water Supply Project (Sherman WTP)	See Grayson County.					
Fannin County Irrigation	None	N/A	N/A	N/A	N/A	N/A	N/A
Fannin County Livestock	None	N/A	N/A	N/A	N/A	N/A	N/A
Fannin County Manufacturing	None	2030	80	See NTMWD in Section 5C.1			
Fannin County Mining	Fannin County Water Supply Project	2020	56	See NTMWD in Section 5C.1			
Fannin County Steam Electric	Lake Texoma (GTUA)	2030	9,000	See GTUA in Section 5C.1			

Table 5D.169
Summary of Recommended Water Management Strategies for Fannin County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation	389	$181,278
Purchase from WWP	9,000	See GTUA in Section 5C.
Fannin County Water Supply Project	12,515	See NTMWD in Section 5C.
Delivery infrastructure	*273*	$2,567,600
Lake Ralph Hall Supply	134	$12,134,600
Groundwater	125	$3,320,608
Total		**$18,204,086**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.



2010 Population: *33,915*

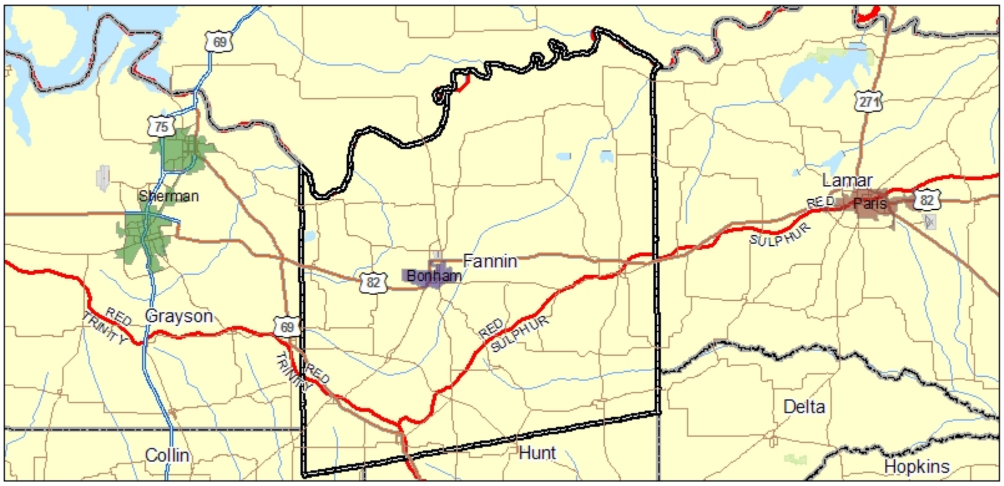
Projected 2070 Population: *138,497*

County Seat: *Bonham*

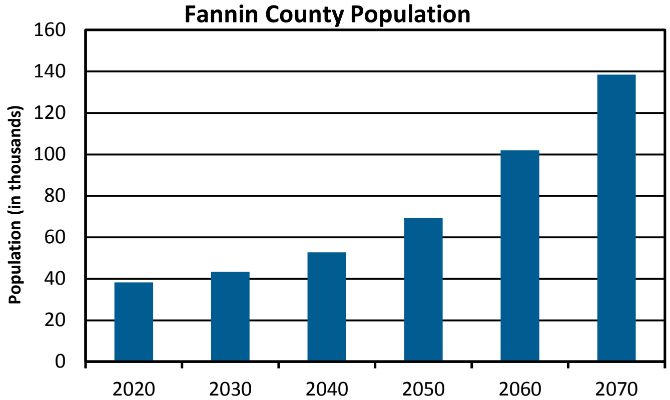
Economy: *Communications; agriculture; government/services; petroleum distribution; tourism; varied manufacturing*

River Basin(s):

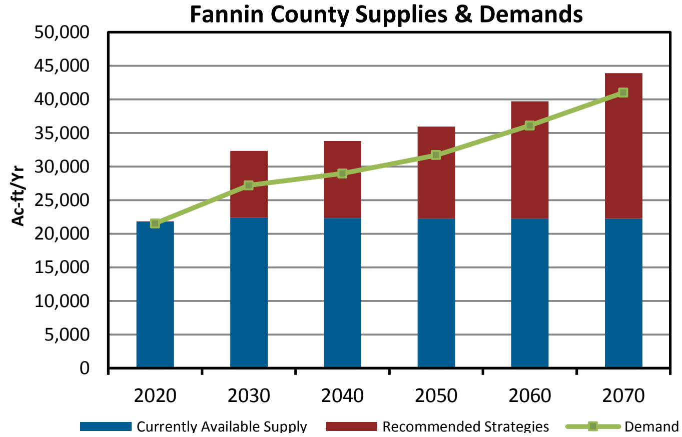
– Trinity (5%), Red (71%), Sulphur (23%)



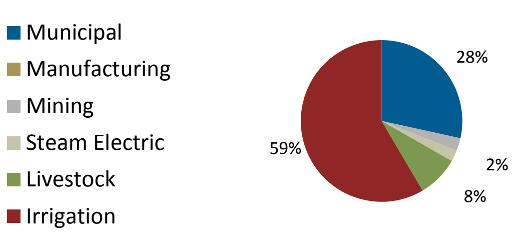
Fannin County Population



Fannin County Supplies & Demands

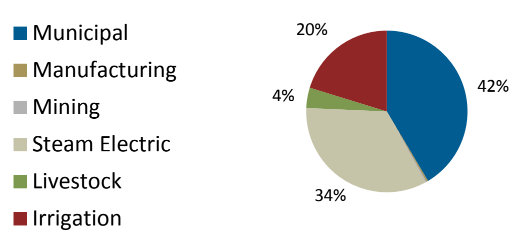


2010 Fannin County Historical Demand
(% of total)



Total=16,911 acre-feet

2070 Fannin County Projected Demand
(% of total)



Total= 41,013 acre-feet

5D.7 Freestone County

Figure 5D.7 is a map of Freestone County. Most Freestone County water user groups use groundwater from the Carrizo-Wilcox aquifer to meet their current needs. By far the largest demand in Freestone County is for steam electric power. Supplies for steam electric power come primarily from surface water:

- Upstream diversions of Lake Livingston water by contract with Trinity River Authority (TRA)
- Purchase of water from Richland-Chambers Reservoir from Tarrant Regional Water District (TRWD) through TRA
- Lake Fairfield supplies.

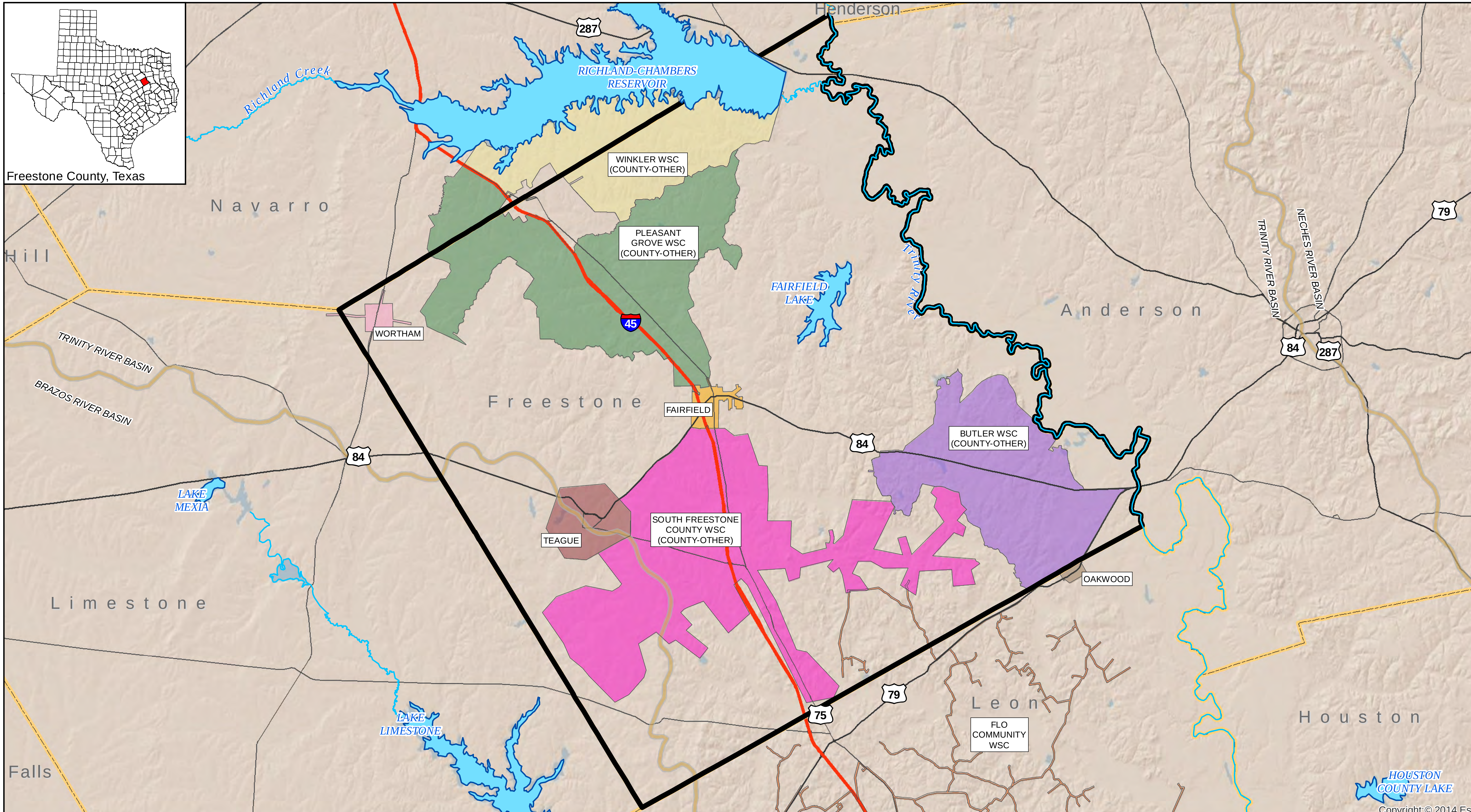
Freestone County is in the Mid-East Texas Groundwater Conservation District [(3)], which also includes Leon and Madison Counties. The Mid-East Texas GCG is part of Groundwater Management Area 12, which along with TWDB has developed a groundwater model and modeled available groundwater values for this area since the publication of the *2011 Region C Water Plan*. Based on the new modeled available groundwater as determined by the Texas Water Development Board (TWBD), current groundwater pumping from the Carrizo-Wilcox aquifer in Freestone County far exceeds the modeled available groundwater. The modeled available groundwater in the Carrizo-Wilcox aquifer is 5,223 acre-feet per year, and 2011 pumping from the aquifer was 9,496 acre-feet per year.

However, a very large portion of the current pumping (about 5,000 acre-feet per year) is associated with the dewatering of lignite mines. By TWDB rules, this use is counted as part of the mining demand for regional planning and requires a reliable supply within the modeled available groundwater for the county. However, dewatering for mining is exempt from permitting and not subject to control by groundwater districts.

As required by TWDB, this plan calls for the use of other sources of supply (surface water from Corsicana and Tarrant Regional Water District) to reduce use of the Carrizo-Wilcox to the modeled available groundwater. It is unclear if any entities will in fact decrease their pumping from the aquifer based on the recommendations in this plan. One result of this approach is that the plan shows a large unmet need for mining use, associated with lignite mine dewatering. We expect the mining and the use to continue regardless.

The proposed water management strategies for Freestone County include:

- Additional water for steam electric power from TRWD (Richland-Chambers Reservoir) through TRA
- Indirect reuse for steam electric power from TRA



FREESE AND NICHOLS

Project No: NTD11336

Service Area	River Basin Divide
County Boundary	River
Freestone County Boundary	Reservoir

N / W / E / S

1 inch = 4.75 miles

0 2.375 4.75 9.5

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Freestone County, Texas

Figure 5D.7

- Purchase of water from TRWD through TRA
- New and rehabilitated water treatment plants
- Purchase of water from Corsicana.

Water management strategies for Freestone County water user groups are discussed below (in alphabetical order). Table 5D.180 shows the estimated capital costs for the Freestone County water management strategies not associated with the wholesale water providers, and Table 5D.181 is a summary of the costs by category. Table 5D.181 is followed by a summary for Freestone County.

Fairfield

Fairfield is a city of about 2,930 people located in central Freestone County and supplies some manufacturing demands in Freestone County. The city's water supply is ground water (Carrizo-Wilcox aquifer). Water management strategies for Fairfield are conservation and purchasing raw water from TRWD and building a new treatment plant. Table 5D.170 shows the projected population and demand, the current supplies, and the water management strategies for Fairfield.

Table 5D.170
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Fairfield

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,232**	**3,486**	**3,662**	**7,000**	**8,000**	**10,000**
Projected Water Demand						
Municipal Demand	673	708	730	1,385	1,580	1,974
Manufacturing customers	60	71	81	90	96	102
Total Projected Demand	***733***	***779***	***811***	***1,475***	***1,676***	***2,076***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	1,192	1,181	1,171	1,162	1,104	998
Carrizo-Wilcox Aquifer for Manufacturing	60	71	81	90	96	102
Total Current Supplies	***1,252***	***1,252***	***1,252***	***1,252***	***1,200***	***1,100***
Need (Demand - Current Supply)	***0***	***0***	***0***	***223***	***476***	***976***
Water Management Strategies						
Water Conservation	6	8	7	32	50	79
Purchase from TRWD with New WTP	0	0	0	191	426	897
Total Water Management Strategies	***6***	***8***	***7***	***223***	***476***	***976***
Reserve (Shortage)	**525**	**481**	**448**	**0**	**0**	**0**

Flo Community Water Supply Corporation

Flo Community WSC serves about 5,600 people in southern Freestone County and in Leon County in Region H. The current water supply for this WSC in Region C is the Carrizo-Wilcox aquifer. The only water management strategy for Flo Community WSC in Region C is conservation. Most of the WSC's service area is in Region H, and the strategies for Region H are covered in that regional water plan. Table 5D.171 shows the projected population and demand, the current supplies, and the water management strategies for Flo Community WSC in Region C.

Table 5D.171
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Flo Community WSC (Region C Only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Region C Population	**521**	**562**	**590**	**611**	**627**	**638**
Projected Water Demand						
Municipal Demand in Region C	40	41	41	42	43	43
Total Projected Region C Demand	***40***	***41***	***41***	***42***	***43***	***43***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	40	41	41	42	43	43
Total Current Supplies	***40***	***41***	***41***	***42***	***43***	***43***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	0	1	1	1
Total Water Management Strategies	***0***	***0***	***0***	***1***	***1***	***1***
Reserve (Shortage)	**0**	**0**	**0**	**1**	**1**	**1**

Freestone County Irrigation

The water supplies for Freestone County irrigation are local supplies and groundwater from the Carrizo-Wilcox aquifer, and the supplies exceed projected demands. The only water management strategy for Freestone County Irrigation is conservation. Table 5D.172 shows the projected demand, the current supplies, and the water management strategies for Freestone County Irrigation.

Table 5D.172
Projected Demand, Current Supplies, and Water Management Strategies for the Freestone County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**298**	**298**	**298**	**298**	**298**	**298**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	298	298	298	298	298	298
Local Supplies	87	87	87	87	87	87
Total Current Supplies	***385***	***385***	***385***	***385***	***385***	***385***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	0	0	1	1
Total Water Management Strategies	***0***	***0***	***0***	***0***	***1***	***1***
Reserve (Shortage)	**87**	**87**	**87**	**87**	**88**	**88**

Freestone County Livestock

The water supplies for Freestone County Livestock are local surface water supplies and groundwater (Carrizo-Wilcox aquifer). These supplies are sufficient to meet demand, and there are no water management strategies. Table 5D.173 shows the projected demand, current supplies, and water management strategy for Freestone County Livestock.

Table 5D.173
Projected Demand, Current Supplies, and Water Management Strategies for the Freestone County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,852**	**1,852**	**1,852**	**1,852**	**1,852**	**1,852**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	809	809	809	809	809	809
Local Supplies	1,043	1,043	1,043	1,043	1,043	1,043
Total Current Supplies	***1,852***	***1,852***	***1,852***	***1,852***	***1,852***	***1,852***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Freestone County Mining

The water supplies for Freestone County Mining are local supplies and groundwater (Carrizo-Wilcox aquifer). The large demand associated with Freestone County Mining is primarily the de-watering of mines during mining operations rather than water required for the mining process. Since the dewatering of mines is not considered to be a true demand, Region C has chosen leave this as an unmet need and is not developing water management strategies to meet this demand. Consequently, there are no water management strategies for Freestone County Mining. Table 5D.174 shows the projected demand, the current supplies, and the water management strategies for Freestone County Mining.

Table 5D.174
Projected Demand, Current Supplies, and Water Management Strategies for the Freestone County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**5,347**	**5,115**	**5,251**	**5,286**	**5,356**	**5,582**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	892	892	892	892	892	892
Local Supplies	120	120	120	120	120	120
Total Current Supplies	***1,012***	***1,012***	***1,012***	***1,012***	***1,012***	***1,012***
Need (Demand - Current Supply)	***4,335***	***4,103***	***4,239***	***4,274***	***4,344***	***4,570***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**-4,335**	**-4,103**	**-4,239**	**-4,274**	**-4,344**	**-4,570**

Freestone County Other

Freestone County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Freestone County Other supply about 9,300 people, and the population is projected to grow significantly. The water supplies for these entities are run-of-the-river local supply, groundwater (Carrizo-Wilcox aquifer), and purchased water from Corsicana. Water management strategies for these entities are conservation, purchasing additional water from Corsicana, and developing a treated water supply from TRWD including new delivery facilities and water treatment facilities. Table 5D.175 shows the projected population and demand, the current supplies, and the water management strategies for Freestone County Other.

Table 5D.175
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Freestone County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**11,719**	**11,719**	**11,719**	**15,056**	**25,000**	**50,000**
Projected Water Demand						
Municipal Demand	1,208	1,163	1,127	1,416	2,332	4,644
Total Projected Water Demand	***1,208***	***1,163***	***1,127***	***1,416***	***2,332***	***4,644***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	848	848	848	848	848	848
Corsicana	121	75	68	76	110	189
Run-of-River local supply	41	41	41	41	41	41
Total Current Supplies	***1,010***	***964***	***957***	***965***	***999***	***1,078***
Need (Demand - Current Supply)	***198***	***199***	***170***	***451***	***1,333***	***3,566***
Water Management Strategies						
Water Conservation	10	14	11	19	39	93
Additional Water from Corsicana	0	40	44	64	119	266
Water from TRWD with new delivery and treatment facilities	189	145	115	368	1,175	3,207
Total Water Management Strategies	***199***	***199***	***170***	***451***	***1,333***	***3,566***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Freestone County Steam Electric Power

The current water supplies for Freestone County Steam Electric Power are groundwater (Carrizo-Wilcox aquifer), a diversion from the Trinity River under TRA's Lake Livingston water right, and water from Lake Fairfield and TRWD. Water management strategies for Freestone County Steam Electric Power are purchasing additional water from TRWD under the current and new contracts and a TRA reuse project. Table 5D.176 shows the projected demand, the current supplies, and the water management strategies for Freestone County Steam Electric Power. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.176
Projected Demand, Current Supplies, and Water Management Strategies for the Freestone County Freestone County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**25,000**	**25,000**	**25,000**	**28,712**	**33,963**	**40,175**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	152	152	152	152	152	152
Lake Fairfield	870	870	870	870	870	870
Trinity River Authority (upstream diversion of Lake Livingston)	20,000	20,000	20,000	20,000	20,000	20,000
TRA (TRWD Sources)	6,726	6,122	5,411	4,781	4,264	3,806
Total Current Supplies	***27,748***	***27,144***	***26,433***	***25,803***	***25,286***	***24,828***
Need (Demand - Current Supply)	***0***	***0***	***0***	***2,909***	***8,677***	***15,347***
Water Management Strategies						
Additional Water from TRWD (current contract)	0	604	1,315	1,945	2,462	2,920
Additional Water from TRWD (new contract)						5,667
Trinity River Authority Reuse				6,760	6,760	6,760
Total Water Management Strategies	***0***	***604***	***1,315***	***8,705***	***9,222***	***15,347***
Reserve (Shortage)	**2,748**	**2,748**	**2,748**	**5,796**	**545**	***0***

Oakwood

Oakwood is a town of about 500 people located in both Freestone and Leon Counties. The larger portion is in Leon County which is in Region H. The water supply for the portion of Oakwood that is in Region C is groundwater from the Carrizo-Wilcox aquifer in Leon County. There are currently no water management strategies. Table 5D.177 shows the projected demand, current supplies, and water management strategies for Oakwood.

Table 5D.177
Projected Demand, Current Supplies,
and Water Management Strategies for Oakwood

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**40**	**43**	**45**	**47**	**48**	**49**
Projected Water Demand						
Municipal Demand	7	7	7	7	7	8
Total Projected Demand	***7***	***7***	***7***	***7***	***7***	***8***
Currently Available Water Supplies	7	7	7	7	7	8
Total Current Supplies	***7***	***7***	***7***	***7***	***7***	***8***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Teague

Teague is a city with a population of about 3,535 people and is located in western Freestone County. The city's water supply is groundwater (Carrizo-Wilcox aquifer). The water management strategy for Teague is conservation and new wells Carrizo-Wilcox aquifer. Table 5D.178 shows the projected population and demand, the current supplies, and the water management strategies for Teague.

Table 5D.178
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Teague

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,750**	**4,000**	**5,600**	**7,050**	**8,500**	**10,000**
Projected Water Demand						
Municipal Demand	380	386	515	637	765	899
Manufacturing customers	40	40	40	40	40	40
Total Projected Demand	***420***	***426***	***555***	***677***	***805***	***939***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	681	681	681	681	681	681

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox Aquifer for Manufacturing	40	40	40	40	40	40
Total Current Supplies	***721***	***721***	***721***	***721***	***721***	***721***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***84***	***218***
Water Management Strategies						
Water Conservation	3	4	5	8	13	18
New wells in Carrizo-Wilcox Aquifer				200	200	200
Total Water Management Strategies	***3***	***4***	***5***	***208***	***213***	***218***
Reserve (Shortage)	**304**	**299**	**171**	**252**	**129**	**0**

Wortham

Wortham is a city located in western Freestone County and has a population of about 1,070. The city's water supply is purchased water from Mexia (which is located in the Brazos G Region). Water management strategies for Wortham are conservation and purchasing additional water from Mexia. Table 5D.179 shows the projected population and demand, the current supplies, and the water management strategies for Wortham.

Table 5D.179
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Wortham

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,175**	**1,267**	**1,331**	**1,378**	**2,300**	**2,600**
Projected Water Demand						
Municipal Demand	168	175	179	183	303	343
Total Projected Demand	***168***	***175***	***179***	***183***	***303***	***343***
Currently Available Water Supplies						
Mexia (in Region G)	157	157	157	157	157	157
Total Current Supplies	***157***	***157***	***157***	***157***	***157***	***157***
Need (Demand - Current Supply)	***11***	***18***	***22***	***26***	***146***	***186***
Water Management Strategies						
Water Conservation	1	2	2	2	5	7
Additional supply from Mexia (Reg G)	10	16	20	24	141	179
Total Water Management Strategies	***11***	***18***	***22***	***26***	***146***	***186***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Costs for Freestone County Water User Groups

Table 5D.180 shows the estimated capital costs for Freestone County water management strategies not covered under the wholesale water providers, and Table 5D.181 summarizes the costs by category and is followed by a summary for Freestone County.

Table 5D.180
Costs for Recommended Water Management Strategies for Freestone County
Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Fairfield	Conservation	2020	79	$56,204	$2.09	$1.07	Q-10
	Purchase water from TRWD	2020	897	$0	$0.97	$0.97	None
	New WTP and transmission	*2050*	*897*	$7,283,000	$2.70	$0.62	Q-132
Flo Community WSC* (Region C only)	Conservation	2020	1	$539	$0.00	$0.00	Q-10
	New Wells	See Region H Plan.					
Freestone County Other	Conservation	2020	93	$24,466	$0.63	$0.00	Q-10
	Additional Corsicana Supply	2020	266	$0	$3.25	$3.25	None
	Increase delivery infrastructure from Corsicana	*2020*	*266*	$5,550,000	$6.30	$0.94	Q-133
	Supply from TRWD	2030	3,207	$0	$0.97	$0.97	None
	New delivery and treatment facilities from TRWD	*2030*	*3,207*	$39,845,900	$4.26	$1.07	Q-134
Oakwood	None	None					
Teague	Conservation	2020	18	$7,053	$0.60	$0.00	Q-10
	New Wells in Carrizo-Wilcox Aquifer	2050	200	$1,145,600	$2.35	$0.87	Q-135
Wortham	Conservation	2020	7	$6,800	$1.75	$0.00	Q-10
	Additional Mexia	2020	179	$0	$2.50	$2.50	None

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Freestone County Irrigation	Conservation	2020	1	$0	$0.95	$0.95	Q-11
Freestone County Livestock	None	N/A	0	$0	N/A	N/A	None
Freestone County Manufacturing	None	N/A	0	$0	N/A	N/A	None
Freestone County Mining	None	N/A	0	$0	N/A	N/A	None
Freestone County Steam Electric	Additional TRWD supplies through TRA	2020	2,920	$0	$0.00	$0.00	None
	TRA direct reuse	2050	6,760	See TRA in Section 5C			

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.181
Summary of Recommended Water Management Strategies for Freestone County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	199	$95,062
Purchase from WWP	4,370	$0
Purchase from WUG	3,099	$0
Delivery infrastructure	*266*	$5,550,000
Treatment plants	*4,104*	$47,128,900
Groundwater	200	$1,145,600
Reuse	6,760	$0
Total		**$53,919,562**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

2010 Population: *19,816*

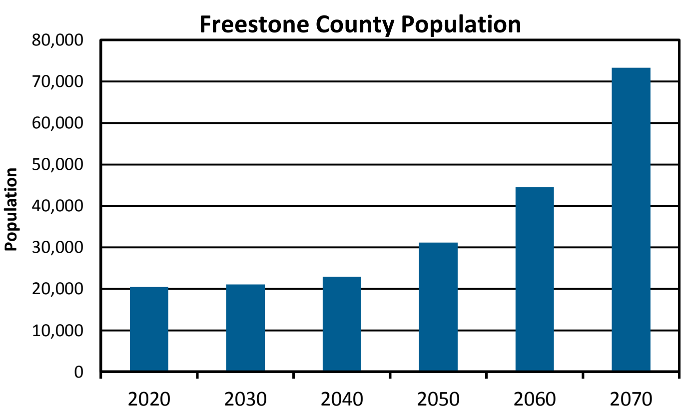
Projected 2070 Population: *73,287*

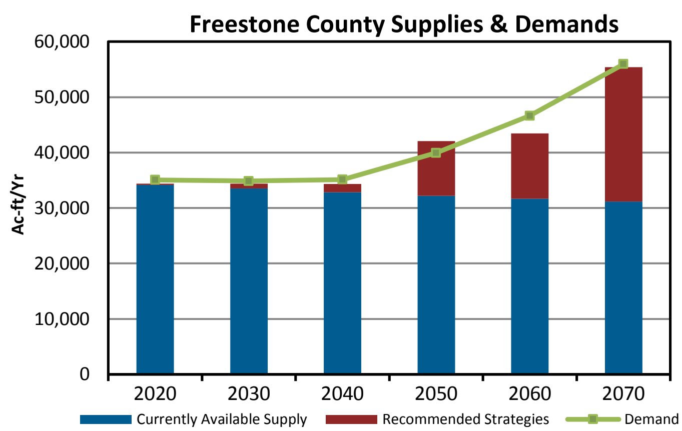
County Seat: *Fairfield*

Economy: *Natural gas, mining, electricity generating plants, agriculture.*

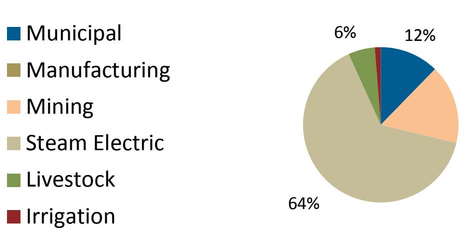
River Basin(s):

- Trinity (89%), Brazos (11%)



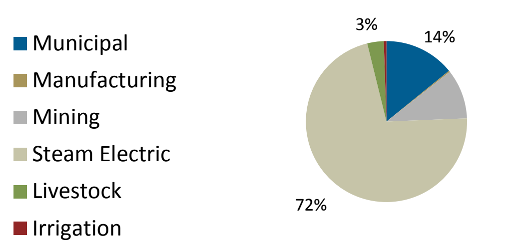


2010 Freestone County Historical Demand (% of total)



Total= 24,158 acre-feet

2070 Freestone County Projected Demand (% of total)



Total= 55,960 acre-feet

5D.8 Grayson County

Figure 5D.8 is a map of Grayson County. Grayson County is in the Red River Groundwater Conservation District. Most Grayson County water user groups use groundwater to meet all or part of their current needs, but there are also large surface water supplies in the county. Sherman operates a desalination plant to treat Lake Texoma water purchased from the Greater Texoma Utility Authority (GTUA). Sherman also supplies raw water from Lake Texoma (from GTUA) to a power plant in the city. Denison uses water from Randell Lake and Lake Texoma, blending the sources to maintain acceptable water quality. Howe and Van Alstyne get treated water from the North Texas Municipal Water District from the Collin-Grayson Municipal Alliance pipeline, developed in cooperation with GTUA.

The proposed Grayson County Water Supply Project will provide additional surface water for water user groups in Grayson County, supplementing the existing groundwater and surface water supplies. The Grayson County Water Supply Project will be developed by GTUA and water suppliers in the county. For the purpose of this plan, the costs of the project ($88.2 million) are included under GTUA and Sherman in Section 5C.1. Elements of the project include:

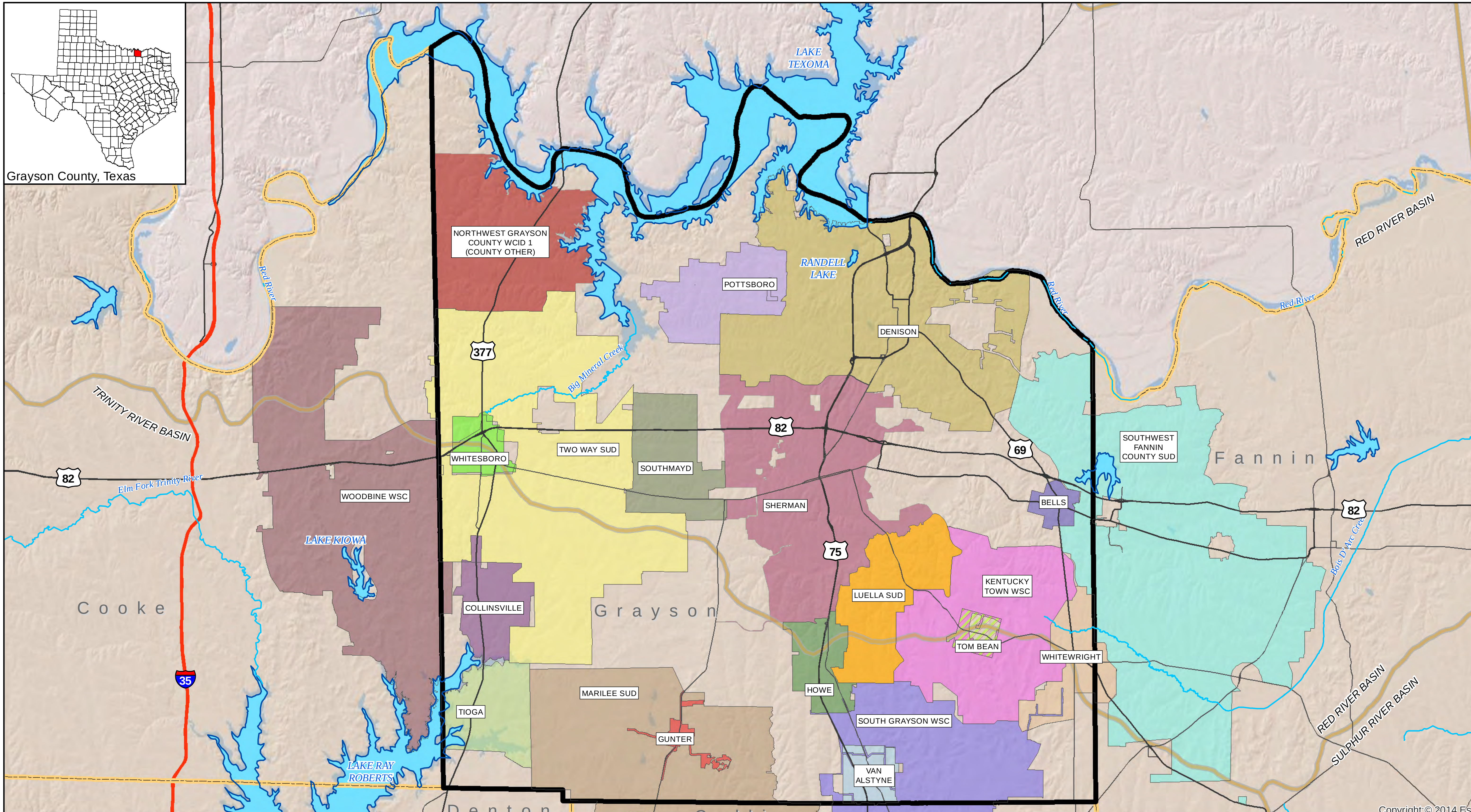
- A new GTUA water right from Lake Texoma, which can be contracted to water suppliers in Grayson County and other parts of the GTUA service area.
- Expansions to raw water facilities delivering water to the Sherman Water Treatment Plant.
- Expansions to the Sherman Water Treatment Plant.
- Construction of new raw water transmission facilities and water treatment plants to treat water from Lake Texoma.
- Construction of treated water transmission lines to deliver water to suppliers.

Table 5D.182 shows the expected supplies from the Grayson County Water Supply Project for Grayson County water user groups.

GTUA will also expand the Collin-Grayson Municipal Alliance project to increase supplies to Howe and Van Alstyne (as well as Anna and Melissa in Collin County). The costs of this project ($63.2 million) are also included under GTUA in Section 5C.1.

Strategies in addition to the surface water projects described above include:

- Denison will use additional Lake Texoma water.
- South Grayson WSC will purchase water from North Texas Municipal Water District through the Collin-Grayson Municipal Alliance in addition to participating in the Grayson County Water Supply Project.
- Many suppliers will use additional groundwater.



FREESE AND NICHOLS

Project No: NTD11336

- Service Area
- Grayson County Boundary
- River Basin Divide
- River
- Reservoir

N / S / E / W

1 inch = 4.5 miles

0 2.25 4.5 9

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Grayson County, Texas

Figure 5D.8

Table 5D.182
Projected Supplies from the Grayson County Water Supply Project

Water User Group	Supplies from the Grayson Co. WSP (Ac-Ft/Yr)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Through GTUA and Sherman						
Sherman	5,171	5,509	6,556	8,369	12,360	19,428
Grayson County Manufacturing	3,679	3,997	4,297	4,548	4,938	5,361
Grayson County Steam Electric	6,163	6,163	6,163	6,163	6,163	6,163
Bells	0	24	48	79	413	608
Grayson County Other	2,197	2,197	2,197	2,197	2,197	3,481
Gunter	0	118	269	421	575	730
Kentucky Town WSC	0	0	100	100	100	100
Luella SUD	0	0	200	200	300	300
Marilee SUD	250	250	250	250	250	250
South Grayson WSC	100	100	100	100	100	100
Southmayd	0	0	50	50	75	100
Tioga	0	5	12	20	325	489
Tom Bean	0	23	46	75	137	316
Whitewright	0	0	50	50	100	100
	17,560	**18,386**	**20,338**	**22,622**	**28,033**	**37,526**
Plant North of Pottsboro						
Grayson County Other	0	200	300	400	500	600
Pottsboro	0	0	62	288	935	2,232
	0	**200**	**362**	**688**	**1,435**	**2,832**
Plant in Northwest Grayson Co.						
Collinsville	0	43	96	159	271	424
South Grayson WSC	0	560	560	560	560	560
Two Way SUD	0	174	350	558	964	1,380
Whitesboro	0	0	0	0	13	179
	0	**777**	**1,006**	**1,277**	**1,808**	**2,543**
Other Grayson County						
Pottsboro Through Denison	362	492	560	560	560	560
Grayson County Steam Electric	0	6,548	6,548	6,548	6,548	6,548
Fannin County Steam Electric	0	9,000	9,000	9,000	9,000	9,000
	362	**16,040**	**16,108**	**16,108**	**16,108**	**16,108**
Total	**17,922**	**35,403**	**37,814**	**40,695**	**47,384**	**59,009**

Note: 2020 demand is met by Sherman from existing sources. Grayson County Water Supply Project is assumed to be implemented before 2030.

Water management strategies for Grayson County water user groups are discussed below (in alphabetical order). Table 5D.205 shows the estimated capital costs for the Grayson County recommended water management strategies not associated with the wholesale water providers, and Table 5D.206 is a summary of the costs by category. Table 5D.207 is a summary of costs for alternative water management strategies not associated with the wholesale water providers. Table 5D.207 is followed by a summary for Grayson County.

Bells

Bells is a city of about 1,400 people located in eastern Grayson County. The city gets its water supply from the Woodbine aquifer. Water management strategies for Bells include conservation, participating in the Grayson County Water Supply Project, and a new well in the Woodbine Aquifer. Table 5D.183 shows the projected population and demand, the current supplies, and the water management strategies for Bells.

Table 5D.183
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Bells

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,648**	**1,943**	**2,234**	**2,568**	**6,000**	**8,000**
Projected Water Demand						
Municipal Demand	175	199	223	254	588	783
Total Projected Demand	***175***	***199***	***223***	***254***	***588***	***783***
Currently Available Water Supplies						
Woodbine Aquifer	175	175	175	175	175	175
Total Current Supplies	***175***	***175***	***175***	***175***	***175***	***175***
Need (Demand - Current Supply)	***0***	***24***	***48***	***79***	***413***	***608***
Water Management Strategies						
Water Conservation	1	2	2	3	10	16
Grayson County Water Supply Project (Sherman)	0	22	46	76	403	592
New well in Woodbine Aquifer	0	145	145	145	145	145
Total Water Management Strategies	***1***	***169***	***193***	***224***	***558***	***753***
Reserve (Shortage)	**1**	**145**	**145**	**145**	**145**	**145**

Collinsville

Collinsville has a population of about 1,600 and is located in western Grayson County. The city gets its water supply from the Trinity aquifer. Water management strategies for Collinsville include conservation and participating in the Grayson County Water Supply Project. Table 5D.184 shows the projected population and demand, the current supplies, and the water management strategies for Collinsville.

Table 5D.184
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Collinsville

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,117**	**2,685**	**3,246**	**3,889**	**5,000**	**6,500**
Projected Water Demand						
Municipal Demand	233	285	338	401	513	666
Total Projected Water Demand	***233***	***285***	***338***	***401***	***513***	***666***
Currently Available Water Supplies						
Trinity Aquifer	242	242	242	242	242	242
Total Current Supplies	***242***	***242***	***242***	***242***	***242***	***242***
Need (Demand - Current Supply)	***0***	***43***	***96***	***159***	***271***	***424***
Water Management Strategies						
Water Conservation	2	3	3	5	9	13
Grayson County Water Supply Project (Northwest WTP)	0	40	93	154	262	411
Total Water Management Strategies	***2***	***43***	***96***	***159***	***271***	***424***
Reserve (Shortage)	**11**	**0**	**0**	**0**	**0**	**0**

Denison

With a population of about 23,000, Denison is one of the two largest cities in Grayson County and is located in the northern part of the county. Denison is a wholesale water provider, and its water supply plans are discussed in Section 5C.2.

Grayson County Irrigation

Table 5D.178 shows the projected demand, the current supplies, and the water management strategies for Grayson County Irrigation. As shown in Table 5D.185, local supplies, groundwater (Trinity and Woodbine aquifers) and Lake Texoma water from the Red River Authority supply irrigation in Grayson County. Water conservation is the only water management strategy for this water user group.

Table 5D.185
Projected Demand, Current Supplies,
and Water Management Strategies for Grayson County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**2,438**	**2,654**	**2,870**	**3,086**	**3,303**	**3,519**
Currently Available Water Supplies						
Trinity Aquifer	503	503	503	503	503	503
Woodbine Aquifer	3,165	3,165	3,165	3,165	3,165	3,165
Red River Authority (Lake Texoma)	150	150	150	150	150	150
Local Supplies	1,091	1,091	1,091	1,091	1,091	1,091
Total Current Supplies	***4,909***	***4,909***	***4,909***	***4,909***	***4,909***	***4,909***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	4	9	12	16	19
Total Water Management Strategies	***0***	***4***	***9***	***12***	***16***	***19***
Reserve (Shortage)	**2,471**	**2,259**	**2,048**	**1,835**	**1,622**	**1,409**

Grayson County Livestock

Table 5D.186 shows the projected demand, current supplies, and water management strategies for Grayson County Livestock. The current supplies are local surface water supplies and groundwater (Trinity and Woodbine aquifers). These sources are sufficient to meet future demands, and there are no water management strategies for this water user group.

Table 5D.186
Projected Demand, Current Supplies,
and Water Management Strategies for Grayson County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**1,458**	**1,458**	**1,458**	**1,458**	**1,458**	**1,458**
Currently Available Water Supplies						
Trinity Aquifer	104	104	104	104	104	104
Woodbine Aquifer	360	360	360	360	360	360
Local Supplies	1,075	1,075	1,075	1,075	1,075	1,075
Total Current Supplies	***1,539***	***1,539***	***1,539***	***1,539***	***1,539***	***1,539***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**81**	**81**	**81**	**81**	**81**	**81**

Grayson County Manufacturing

Table 5D.187 shows the projected demand, the current supplies, and the water management strategies for Grayson County Manufacturing. Current supplies include Sherman (from GTUA and Lake Texoma), Denison (from Lake Randell), Howe (from GTUA and NTMWD), local supplies, and groundwater (Woodbine aquifer). Water conservation and additional supplies from Sherman and Howe are the water management strategies for this water user group. An alternative strategy would be direct reuse from Sherman.

Table 5D.187
Projected Demand, Current Supplies,
and Water Management Strategies for Grayson County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**4,905**	**5,329**	**5,729**	**6,065**	**6,584**	**7,147**
Currently Available Water Supplies						
Sherman (GTUA - Lake Texoma)	3,619	3,718	3,595	3,297	2,789	2,100
Denison (Lake Randell)	736	799	859	910	988	1,072
Howe (NTMWD through GTUA)	45	41	40	40	41	41
Woodbine Aquifer	1,200	1,200	1,200	1,200	1,200	1,200
Local Supplies	30	30	30	30	30	30
Total Current Supplies	***5,630***	***5,788***	***5,724***	***5,477***	***5,048***	***4,443***
Need (Demand - Current Supply)	***0***	***0***	***5***	***588***	***1,536***	***2,704***
Water Management Strategies						
Water Conservation	0	11	122	175	187	203
Additional Howe	4	12	17	21	25	30
Additional Sherman (Grayson County Water Supply Project)	60	268	580	1,076	1,962	3,058
Total Water Management Strategies	***64***	***291***	***719***	***1,272***	***2,174***	***3,291***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Reserve (Shortage)	**789**	**750**	**714**	**684**	**638**	**587**
Alternative Water Management Strategy						
Direct Reuse from Sherman	561	561	561	561	561	561

Grayson County Mining

Table 5D.188 shows the projected demand, the current supplies, and the water management strategies for Grayson County Mining. Grayson County Mining is supplied from groundwater (Trinity and Woodbine aquifers) and Lake Texoma water from the Red River Authority. The only water management strategy for this water user group is a new well in the Trinity Aquifer. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5D.188
Projected Demand, Current Supplies,
and Water Management Strategies for Grayson County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**79**	**91**	**107**	**123**	**142**	**163**
Currently Available Water Supplies						
Trinity Aquifer	22	22	22	22	22	22
Red River Authority (Lake Texoma)	100	100	100	100	100	100
Total Current Supplies	***122***	***122***	***122***	***122***	***122***	***122***
Need (Demand - Current Supply)	***0***	***0***	***0***	***1***	***20***	***41***
Water Management Strategies						
New Well in Trinity Aquifer (Red Basin)				41	41	41
Total Water Management Strategies	***0***	***0***	***0***	***41***	***41***	***41***
Reserve (Shortage)	**43**	**31**	**15**	**40**	**21**	**0**

Grayson County Other

Grayson County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Grayson County Other supply about 20,000 people, and the number is expected to grow. The suppliers receive their water supply from Denison (Lake Texoma and Lake Randell), the Red River Authority (Lake Texoma), Sherman (GTUA and Lake Texoma), and groundwater (Trinity, Woodbine, and other aquifers). Water management strategies for these entities include conservation and participation in the Grayson County Water Supply Project. Table 5D.189 shows the projected population and demand, the current supplies, and the water management strategies for Grayson County Other.

Table 5D.189
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Grayson County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**21,617**	**21,617**	**21,617**	**21,617**	**30,000**	**50,000**
Projected Water Demand						
Municipal Demand	2,746	2,642	2,554	2,536	3,494	5,801
Total Projected Water Demand	***2,746***	***2,642***	***2,554***	***2,536***	***3,494***	***5,801***
Currently Available Water Supplies						
Denison (Lake Randell)	60	60	60	60	60	60
Red River Authority (Lake Texoma)	641	641	641	641	641	641
Denison (Lake Texoma)	340	340	340	340	340	340
Sherman (GTUA - Lake Texoma)	2,161	2,043	1,838	1,593	1,241	1,363
Trinity Aquifer	750	750	750	750	750	750
Woodbine Aquifer	800	800	800	800	800	800
Total Current Supplies	***4,752***	***4,634***	***4,429***	***4,184***	***3,832***	***3,954***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***1,847***
Water Management Strategies						
Water Conservation	23	31	26	34	58	116
Grayson County Water Supply Project (Sherman WTP)	13	123	333	570	898	2,002
Grayson County Water Supply Project (North WTP)	0	200	300	400	500	600
Grayson County Water Supply Project (Northwest WTP)	0	560	560	560	560	560
Total Water Management Strategies	***36***	***914***	***1,219***	***1,564***	***2,016***	***3,278***
Reserve (Shortage)	**2,041**	**2,905**	**3,093**	**3,211**	**2,353**	**1,430**

Grayson County Steam Electric Power

Table 5D.190 shows the projected demand, the current supplies, and the water management strategies for Grayson County Steam Electric Power. The current supply for this water user group is treated water from Sherman (GTUA and Lake Texoma). The water management strategy is additional water from GTUA (Lake Texoma). An alternative strategy would be direct reuse from Sherman. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.190
Projected Demand, Current Supplies,
and Water Management Strategies for Grayson County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**6,163**	**12,711**	**12,711**	**12,711**	**12,711**	**12,711**
Currently Available Water Supplies						
Sherman (GTUA - Lake Texoma)	6,163	6,163	6,163	6,163	6,163	6,163
Total Current Supplies	***6,163***	***6,163***	***6,163***	***6,163***	***6,163***	***6,163***
Need (Demand - Current Supply)	***0***	***6,548***	***6,548***	***6,548***	***6,548***	***6,548***
Water Management Strategies						
GTUA (Lake Texoma)	0	6,548	6,548	6,548	6,548	6,548
Total Water Management Strategies	***0***	***6,548***	***6,548***	***6,548***	***6,548***	***6,548***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Alternative Water Management Strategy						
Direct Reuse from Sherman		4,352	4,771	5,496	6,548	6,548

Gunter

Gunter is located in southern Grayson County and has a population of about 1,500. The city gets its current water supply from the Trinity aquifer. Water management strategies for Gunter include conservation, new wells in the Trinity aquifer for additional groundwater production, and participating in the Grayson County Water Supply Project. Table 5D.191 shows the projected population and demand, the current supplies, and the water management strategies for Gunter.

Table 5D.191
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Gunter

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (In City Only)	**2,200**	**3,000**	**4,000**	**5,000**	**6,000**	**7,000**
Projected Water Demand						
Municipal Demand	355	473	624	776	930	1,085
Total Projected Demand	***355***	***473***	***624***	***776***	***930***	***1,085***
Currently Available Water Supplies						
Trinity Aquifer	355	355	355	355	355	355
Total Current Supplies	***355***	***355***	***355***	***355***	***355***	***355***
Need (Demand - Current Supply)	***0***	***118***	***269***	***421***	***575***	***730***
Water Management Strategies						
Water Conservation	3	21	6	10	16	22
New wells in Trinity Aqufier	50	100	100	100	100	100
Grayson County Water Supply Project (Sherman WTP)	0	97	263	411	559	708
Total Water Management Strategies	***53***	***218***	***369***	***521***	***675***	***830***
Reserve (Shortage)	**53**	**100**	**100**	**100**	**100**	**100**

Howe

Howe is a city of about 2,600 located in southern Grayson County, on the border between the Red and Trinity River basins. The city of Howe provides water to a portion of Grayson County Manufacturing. The city gets its current supplies from the Woodbine aquifer and the North Texas Municipal Water District (NTMWD) via GTUA and the Collin-Grayson Municipal Alliance Project. Water management strategies for Howe include conservation and additional water from NTMWD (from an expanded Collin-Grayson Municipal Alliance project). Table 5D.192 shows the projected population and demand, the current supplies, and the water management strategies for Howe. An alternative strategy would be the Grayson County Water Supply Project.

Table 5D.192
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Howe

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,000**	**3,500**	**4,000**	**4,500**	**5,000**	**5,500**
Projected Water Demand						
Municipal Demand	287	318	352	390	432	474
Grayson County Manufacturing	49	53	57	61	66	71
Total Projected Demand	***336***	***371***	***409***	***451***	***498***	***545***
Currently Available Water Supplies						
Woodbine Aquifer	282	282	282	282	282	282
North Texas Municipal WD (Collin-Grayson Municipal Alliance Pipeline)	5	28	49	72	94	111
North Texas MWD (Collin-Grayson MA for Grayson Co Manufacturing)	45	41	40	40	41	41
Total Current Supplies	***332***	***350***	***372***	***394***	***417***	***434***
Need (Demand - Current Supply)	***4***	***21***	***37***	***56***	***81***	***111***
Water Management Strategies						
Water Conservation	2	4	4	5	7	9
Additional Water from NTMWD (Expanded CGMA Pipeline)	0	4	17	31	49	72
Additional Water from NTMWD (Expanded CGMA Pipeline for Grayson Co Manufacturing)	4	12	17	21	25	30
Total Water Management Strategies	***6***	***21***	***37***	***57***	***81***	***111***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**
Alternative Water Management Strategy						
Grayson County Water Supply Project (Sherman WTP)	2	17	33	51	74	102

Kentucky Town Water Supply Corporation

The Kentucky Town WSC serves about 3,000 people in south eastern Grayson County. The WSC gets its current water supply from the Woodbine aquifer, and water management strategies include conservation and participation in the Grayson County Water Supply Project. Table 5D.193 shows the projected population and demand, the current supplies, and the water management strategies for Kentucky Town WSC.

Table 5D.193
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Kentucky Town WSC

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,945**	**3,532**	**4,111**	**4,776**	**6,000**	**7,500**
Projected Water Demand						
Municipal Demand	367	424	482	554	693	865
Total Projected Demand	***367***	***424***	***482***	***554***	***693***	***865***
Currently Available Water Supplies						
Woodbine Aquifer	865	865	865	865	865	865
Total Current Supplies	***865***	***865***	***865***	***865***	***865***	***865***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	3	5	5	7	12	17
Grayson County Water Supply Project (Sherman WTP)	0	0	95	93	88	83
Total Water Management Strategies	***3***	***5***	***100***	***100***	***100***	***100***
Reserve (Shortage)	**501**	**446**	**483**	**411**	**272**	**100**

Luella Special Utility District

The Luella SUD serves about 3,400 people in central Grayson County. The SUD gets its current water supply from the Woodbine aquifer, and water management strategies include conservation and participation in the Grayson County Water Supply Project. Table 5D.194 shows the projected population and demand, the current supplies, and the water management strategies for Luella SUD.

Table 5D.194
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Luella Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,800**	**4,380**	**4,952**	**5,609**	**6,306**	**7,055**
Projected Water Demand						
Municipal Demand	400	444	490	548	614	687
Total Projected Demand	***400***	***444***	***490***	***548***	***614***	***687***

(Values in Ac-Ft/Yr) Currently Available Water Supplies	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Woodbine Aquifer	687	687	687	687	687	687
Total Current Supplies	***687***	***687***	***687***	***687***	***687***	***687***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	3	5	5	7	10	14
Grayson County Water Supply Project (Sherman WTP)	0	0	195	193	290	286
Total Water Management Strategies	***3***	***5***	***200***	***200***	***300***	***300***
Reserve (Shortage)	**290**	**248**	**397**	**339**	**373**	**300**

Marilee Special Utility District

Marilee SUD (Formerly called Gunter Rural WSC) serves about 4,600 people and is located in northeastern Collin County and southwestern Grayson County. The SUD currently gets its water supplies from treated water purchased from Sherman and from the Trinity aquifer. Water management strategies include conservation and additional water from Sherman (through the Grayson County Water Supply Project). Table 5D.195 shows the projected population and demand, the current supplies, and the water management strategies for Marilee SUD.

Table 5D.195
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Marilee Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,410**	**6,410**	**6,298**	**6,298**	**6,201**	**6,201**
Projected Water Demand						
Municipal Demand	946	931	904	901	886	885
Total Projected Demand	***946***	***931***	***904***	***901***	***886***	***885***
Currently Available Water Supplies						
Trinity Aquifer	946	946	946	946	946	946
Sherman	246	233	209	181	141	98
Total Current Supplies	***1,192***	***1,179***	***1,155***	***1,127***	***1,087***	***1,044***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	8	11	9	12	15	18
Additional Water from Sherman (Grayson Co WSP)	0	6	32	57	94	134
Total Water Management Strategies	***8***	***17***	***41***	***69***	***109***	***152***
Reserve (Shortage)	**254**	**265**	**292**	**295**	**310**	**311**

Pottsboro

Pottsboro is a city of 2,200 located in northern Grayson County, near Lake Texoma. The city gets its current supplies from the Woodbine aquifer and treated water purchased from Denison. Water management strategies for Pottsboro include conservation, additional water from Denison, and participation in the Grayson County Water Supply Project. Table 5D.196 shows the projected population and demand, the current supplies, and the water management strategies for Pottsboro.

Table 5D.196
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Pottsboro

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,896**	**3,745**	**4,582**	**6,000**	**10,000**	**18,000**
Projected Water Demand						
Municipal Demand	491	621	751	977	1,624	2,921
Total Projected Demand	***491***	***621***	***751***	***977***	***1,624***	***2,921***
Currently Available Water Supplies						
Woodbine Aquifer	129	129	129	129	129	129
Denison	362	441	458	419	357	288
Total Current Supplies	***491***	***570***	***587***	***548***	***486***	***417***
Need (Demand - Current Supply)	***0***	***51***	***164***	***429***	***1,138***	***2,504***
Water Management Strategies						
Water Conservation	4	7	15	28	60	117
Additional Denison	0	51	102	141	203	272
Grayson County Water Supply Project (North WTP)	0	0	47	260	875	2,115
Total Water Management Strategies	***4***	***58***	***164***	***429***	***1,138***	***2,504***
Reserve (Shortage)	**4**	**7**	**0**	**0**	**0**	**0**

Sherman

Sherman is the largest city in Grayson County, with a population of about 39,000, and is located in the center of the county. Sherman is a wholesale water provider, and its water supply plans are discussed in Section 5C.2.

South Grayson Water Supply Corporation

South Grayson Water Supply Corporation is located in southern Grayson County and northern Collin County and has an estimated service area population of 4,200. The WSC gets its current supplies from the Trinity and Woodbine aquifers. Water management strategies for South Grayson WSC include conservation and participation in the Grayson County Water Supply Project. Table 5D.197 shows the projected population and demand, the current supplies, and the water management strategies for South Grayson WSC.

Table 5D.197
Projected Population and Demand, Current Supplies, and Water Management Strategies for South Grayson Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,500**	**5,000**	**6,000**	**6,500**	**7,000**	**7,500**
Projected Water Demand						
Municipal Demand	551	599	708	762	818	875
Total Projected Demand	***551***	***599***	***708***	***762***	***818***	***875***
Currently Available Water Supplies						
Trinity Aquifer	275	275	275	275	275	275
Woodbine Aquifer	551	551	551	551	551	551
Total Current Supplies	***826***	***826***	***826***	***826***	***826***	***826***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***49***
Water Management Strategies						
Water Conservation	5	7	7	10	14	18
Grayson County Water Supply Project (Sherman WTP)	95	93	93	90	86	82
Total Water Management Strategies	***100***	***100***	***100***	***100***	***100***	***100***
Reserve (Shortage)	**375**	**327**	**218**	**164**	**108**	**51**

Southmayd

Southmayd is located in central Grayson County and has a population of about 1,000. The city gets its current supplies from the Woodbine aquifer. Water management strategies for Southmayd include conservation, a new well in the Woodbine aquifer, and participation in the Grayson County Water Supply Project. Table 5D.198 shows the projected population and demand, the current supplies, and the water management strategies for Southmayd.

Table 5D.198
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Southmayd

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**1,098**	**1,222**	**1,344**	**1,483**	**2,000**	**3,000**
Projected Water Demand						
Municipal Demand	97	103	110	119	159	238
Total Projected Demand	***97***	***103***	***110***	***119***	***159***	***238***
Currently Available Water Supplies						
Woodbine Aquifer	161	161	161	161	161	161
Total Current Supplies	***161***	***161***	***161***	***161***	***161***	***161***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***77***
Water Management Strategies						
Water Conservation	1	1	1	2	3	5
Grayson County Water Supply Project (North WTP)	0	0	49	48	72	95
New Well Woodbine Aquifer						77
Total Water Management Strategies	***1***	***1***	***50***	***50***	***75***	***177***
Reserve (Shortage)	**65**	**59**	**101**	**92**	**77**	**100**

Southwest Fannin County Special Utility District

Southwest Fannin County SUD serves about 5,000 people in western Fannin County and eastern Grayson County. The water supply plan for Southwest Fannin County SUD is discussed under Fannin County in Section 5D.6.

Tioga

Tioga is a city of about 800 people located in southwestern Grayson County. The city gets its water supply from the Trinity aquifer. Water management strategies for Tioga include conservation and participating in the Grayson County Water Supply Project (through the Sherman Water Treatment Plant). Table 5D.199 shows the projected population and demand, the current supplies, and the water management strategies for Tioga. An alternative water management strategies for is participating in the Grayson County Water Supply Project (through the Northwest Water Treatment Plant).

Table 5D.199
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Tioga

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**865**	**936**	**1,006**	**1,087**	**3,500**	**4,800**
Projected Water Demand						
Municipal Demand	119	124	131	139	444	608
Total Projected Demand	***119***	***124***	***131***	***139***	***444***	***608***
Currently Available Water Supplies						
Trinity Aquifer	119	119	119	119	119	119
Total Current Supplies	***119***	***119***	***119***	***119***	***119***	***119***
Need (Demand - Current Supply)	***0***	***5***	***12***	***20***	***325***	***489***
Water Management Strategies						
Water Conservation	1	1	1	2	7	12
Grayson County Water Supply Project (Sherman WTP)	0	4	11	18	318	477
Total Water Management Strategies	***1***	***5***	***12***	***20***	***325***	***489***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**
Alternative Water Management Strategy						
Grayson County Water Supply Project (Northwest WTP)	0	4	11	18	318	477

Tom Bean

Tom Bean has a population of about 1,100 and is located in southeastern Grayson County. The city gets its water supply from the Woodbine aquifer. Water management strategies for Tom Bean include conservation and participating in the Grayson County Water Supply Project. Table 5D.200 shows the projected population and demand, the current supplies, and the water management strategies for Tom Bean.

Table 5D.200
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Tom Bean

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**1,176**	**1,328**	**1,477**	**1,649**	**2,000**	**3,000**
Projected Water Demand						
Municipal Demand	222	245	268	297	359	538
Total Projected Demand	***222***	***245***	***268***	***297***	***359***	***538***
Currently Available Water Supplies						
Woodbine Aquifer	222	222	222	222	222	222
Total Current Supplies	***222***	***222***	***222***	***222***	***222***	***222***
Need (Demand - Current Supply)	***0***	***23***	***46***	***75***	***137***	***316***
Water Management Strategies						
Water Conservation	2	23	64	73	90	137
Grayson County Water Supply Project (Sherman WTP)	0	0	0	2	47	179
Total Water Management Strategies	***2***	***23***	***64***	***75***	***137***	***316***
Reserve (Shortage)	**2**	**0**	**18**	**0**	**0**	**0**

Two Way Special Utility District

Two Way SUD serves about 4,900 people in eastern Cooke County and western Grayson County. The SUD currently gets its water supplies from the Trinity aquifer. Water management strategies for Two Way SUD include conservation and water from the Grayson County Water Supply Project. Table 5D.201 shows the projected population and demand, the current supplies, and the water management strategies for Two Way SUD.

Table 5D.201
Projected Population and Demand, Current Supplies, and Water Management Strategies for Two Way Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,394**	**8,221**	**10,020**	**12,085**	**16,000**	**20,000**
Projected Water Demand						
Municipal Demand	710	884	1,060	1,268	1,674	2,090
Total Projected Demand	***710***	***884***	***1,060***	***1,268***	***1,674***	***2,090***
Currently Available Water Supplies						
Trinity Aquifer	710	710	710	710	710	710
Total Current Supplies	***710***	***710***	***710***	***710***	***710***	***710***
Need (Demand - Current Supply)	***0***	***174***	***350***	***558***	***964***	***1,380***
Water Management Strategies						
Water Conservation	6	9	11	17	28	42
Grayson County Water Supply Project (Northwest WTP)	0	165	339	541	936	1,338
Total Water Management Strategies	***6***	***174***	***350***	***558***	***964***	***1,380***
Reserve (Shortage)	**6**	**0**	**0**	**0**	**0**	**0**

Van Alstyne

Van Alstyne is a city of about 3,100 located in southern Grayson County on the border with Collin County. The city gets its current supplies from the Trinity and Woodbine aquifers and the North Texas Municipal Water District (NTMWD) via GTUA and the Collin-Grayson Municipal Alliance Project. Water management strategies for Van Alstyne include conservation, additional water from NTMWD via GTUA (from an expanded Collin-Grayson Municipal Alliance project), and water system improvements needed to take delivery of additional water from NTMWD. Table 5D.202 shows the projected population and demand, the current supplies, and the water management strategies for Van Alstyne.

Table 5D.202
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Van Alstyne

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,735**	**4,530**	**5,314**	**6,214**	**18,000**	**25,000**
Projected Water Demand						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Municipal Demand	517	608	700	811	2,337	3,243
Total Projected Demand	***517***	***608***	***700***	***811***	***2,337***	***3,243***
Water Management Strategies						
Currently Available Water Supplies						
Trinity Aquifer	0	0	0	0	0	0
Woodbine Aquifer	517	517	517	517	517	517
Greater Texoma Utility Authority (Collin-Grayson Municipal Alliance Pipeline from NTMWD)	0	70	129	196	1,135	1,291
Total Current Supplies	***517***	***587***	***646***	***713***	***1,652***	***1,808***
Need (Demand - Current Supply)	***0***	***21***	***54***	***98***	***685***	***1,435***
Water Management Strategies						
Water Conservation	4	7	7	11	39	65
Additional Water from GTUA and Expanded CGMA Pipeline	0	14	47	87	646	1,370
Water System Improvements needed to take delivery of water from GTUA	*0*	*14*	*47*	*87*	*646*	*1,370*
Total Water Management Strategies	***4***	***21***	***54***	***98***	***685***	***1,435***
Reserve (Shortage)	**4**	**0**	**0**	**0**	**0**	**0**

Whitesboro

Whitesboro is a city of about 3,800 people located in western Grayson County. The city gets its water supply from the Trinity aquifer. Water management strategies for Whitesboro include conservation and participating in the Grayson County Water Supply Project (through the Northwest Water Treatment Plant). Table 5D.203 shows the projected population and demand, the current supplies, and the water management strategies for Whitesboro. An alternative water management strategies for Whitesboro would be participating in the Grayson County Water Supply Project through the Sherman Water Treatment Plant.

Table 5D.203
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Whitesboro

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,834**	**3,882**	**3,929**	**3,983**	**5,000**	**6,500**
Projected Water Demand						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Municipal Demand	469	458	450	449	560	726
Total Projected Demand	***469***	***458***	***450***	***449***	***560***	***726***
Currently Available Water Supplies						
Trinity Aquifer	547	547	547	547	547	547
Total Current Supplies	***547***	***547***	***547***	***547***	***547***	***547***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***13***	***179***
Water Management Strategies						
Water Conservation	4	5	5	6	9	15
Grayson County Water Supply Project (Northwest WTP)	0	0	0	0	4	164
Total Water Management Strategies	***4***	***5***	***5***	***6***	***13***	***179***
Reserve (Shortage)	**82**	**94**	**102**	**104**	**0**	**0**
Alternative Water Management Strategies						
Grayson County Water Supply Project (Sherman WTP)	0	0	0	0	4	164

Whitewright

Whitewright is a city of about 1,600 people located in eastern Grayson County with a small area in Fannin County. The city gets its current water supply from the Woodbine aquifer, and water management strategies include conservation and participating in the Grayson County Water Supply Project. Table 5D.204 shows the projected population and demand, the current supplies, and the water management strategies for Whitewright.

Table 5D.204
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Whitewright

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,605**	**1,625**	**1,645**	**1,665**	**1,765**	**1,865**
Projected Water Demand						
Municipal Demand	222	216	212	212	224	237
Total Projected Demand	***222***	***216***	***212***	***212***	***224***	***237***
Currently Available Water Supplies						
Woodbine Aquifer	284	284	284	284	284	284

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***284***	***284***	***284***	***284***	***284***	***284***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	2	3	4	5
Grayson County Water Supply Project (Sherman WTP)	0	0	48	47	96	95
Total Water Management Strategies	***2***	***3***	***50***	***50***	***100***	***100***
Reserve (Shortage)	**64**	**71**	**122**	**122**	**160**	**147**

Woodbine Water Supply Corporation

Woodbine WSC serves about 5,700 people in eastern Cooke County and western Grayson County. The water supply plan for Woodbine WSC is discussed under Cooke County in Section 5D.2.

Costs for Grayson County Water User Groups

Table 5D.205 shows the estimated capital costs for Grayson County recommended water management strategies not covered under the wholesale water providers. Table 5D.206 summarizes the costs by category. Table 5D.207 shows the estimated capital costs for Grayson County alternative water management strategies not covered under the wholesale water providers. Table 5D.207 is followed by a summary for Grayson County.

Table 5D.205
Costs for Recommended Water Management Strategies for Grayson County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Bells	Conservation	2020	16	$250,000	$64.20	$0.00	Q-10
	Grayson County WSP (Sherman WTP)	2030	592	See GTUA in Section 5C.			
	New well in Woodbine Aquifer	2030	145	$1,200,000	$3.38	$1.26	Q-136

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Collinsville	Conservation	2020	13	$4,551	$0.58	$0.00	Q-10
	Grayson County WSP (Northwest WTP)	2030	411	See GTUA in Section 5C.			
Denison	Conservation	2020	1,144	$322,613	$2.48	$0.73	Q-10
	Other measures	See Denison in Section 5C.2.					
Grayson County Other	Conservation	2020	116	$61,207	$0.68	$0.00	Q-10
	Grayson County WSP (Sherman WTP)	2020	2,002	See GTUA in Section 5C.			
	Grayson County WSP (North WTP)	2030	600	See GTUA in Section 5C.			
	Grayson County WSP (Northwest WTP)	2030	560	See GTUA in Section 5C.			
Gunter	Conservation	2020	22	$20,228	$1.73	$0.00	Q-10
	New wells	2020	100	$2,080,600	$14.30	$3.62	
	Grayson County WSP (Sherman WTP)	2030	708	See GTUA in Section 5C.			
Howe	Conservation	2020	9	$1,436	$0.18	$0.00	Q-10
	Additional Collin-Grayson Municipal Alliance	2020	102	See GTUA in Section 5C.			
Kentucky Town WSC	Conservation	2020	17	$7,487	$0.64	$0.00	Q-10
	Grayson County WSP (Sherman WTP)	2040	95	See GTUA in Section 5C.			
Luella SUD	Conservation	2020	14	$21,603	$1.85	$0.00	Q-10
	Grayson County WSP (Sherman WTP)	2040	290	See GTUA in Section 5C.			
Marilee SUD*	Conservation	See Collin County.					
	Additional Sherman	See Collin County.					
Pottsboro	Conservation	2020	117	$50,227	$2.75	$1.21	Q-10
	Additional Denison supplies	2030	272	$0	$2.50	$2.50	None
	Grayson County WSP (North WTP)	2040	2,115	See GTUA in Section 5C.			
Sherman	Conservation	2020	992	$1,044,775	$2.80	$0.48	Q-10
	Other measures	See Sherman in Section 5C.2.					

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
South Grayson WSC*	Conservation	2020	18	$32,462	$1.67	$0.00	Q-10
	Grayson County WSP (Sherman WTP)	2020	95	See GTUA in Section 5C.			
Southmayd	Conservation	2020	5	$5,277	$1.36	$0.00	Q-10
	New Well in Woodbine	2070	77	$1,068,000	$4.69	$1.15	Q-141
	Grayson County WSP (Sherman WTP)	2040	95	See GTUA in Section 5C.			
Southwest Fannin County SUD*	Conservation	See Fannin County.					
	New Well in Woodbine with Transmission Facilities	See Fannin County.					
	Fannin County WSP	See Fannin County.					
Tioga	Conservation	2020	12	$8,424	$2.16	$0.00	Q-10
	Grayson County WSP (Sherman WTP)	2030	477	See GTUA in Section 5C.			
Tom Bean	Conservation	2020	137	$16,765	$0.27	$1.02	Q-10
	Grayson County WSP (Sherman WTP)	2050	179	See GTUA in Section 5C.			
Two Way SUD*	Conservation	2020	42	$34,470	$1.48	$0.00	Q-10
	Grayson County WSP (Northwest WTP)	2030	1,338	See GTUA in Section 5C.			
Van Alstyne	Conservation	2020	65	$35,411	$2.27	$0.00	Q-10
	Additional Collin-Grayson Municipal Alliance	2030	1,370	See GTUA in Section 5C.			
	Water System Improvements	2020	1,370	$2,180,800	$2.35	$1.94	Q-142
Whitesboro	Conservation	2020	15	$12,279	$0.79	$0.00	Q-10
	Grayson County WSP (Northwest WTP)	2060	164	See GTUA in Section 5C.			
Whitewright*	Conservation	2020	5	$11,395	$1.46	$0.00	Q-10
	Grayson County WSP (Sherman WTP)	2020	96	See GTUA in Section 5C.			

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Woodbine WSC*	Conservation	See Cooke County.					
	Connect to Gainesville	2020	See Gainesville in Section 5C.2.				
Grayson County Irrigation	Conservation	2030	19	$0	$0.95	$0.95	None
Grayson County Livestock	None	None					
Grayson County Manufacturing	Conservation	2020	203	$0	$0.95	$0.95	Q-11
	Grayson County WSP (Sherman WTP)	2020	3,058	See GTUA in Section 5C.			
	Additional Howe (Collin-Grayson Municipal Alliance)	2020	30	See GTUA in Section 5C.			
Grayson County Mining	New well in Trinity Aquifer	2050	41	$164,000	$1.42	$0.37	Q-138
Grayson County Steam Electric	Additional Lake Texoma (GTUA)	2030	6,548	See GTUA in Section 5C.			

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

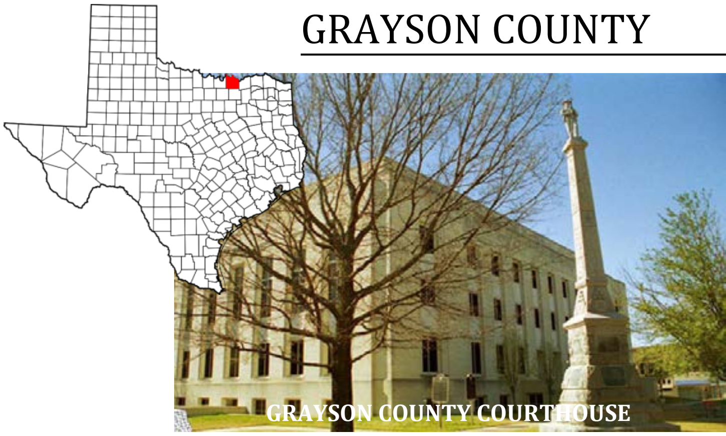
Table 5D.206
Summary of Recommended Water Management Strategies for Grayson County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	2,981	$1,940,610
Grayson County Water Supply Project	12,875	$0
Purchase from WWP	8,291	$0
Purchase from WUG	30	$0
Delivery infrastructure	*1,370*	$2,180,800
Groundwater	363	$4,512,600
Total		**$8,634,010**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

Table 5D.207
Summary of Alternative Water Management Strategies for Grayson County Not Covered Under Wholesale Water Providers

Type of Strategy	Entity	Quantity (Ac-Ft/Yr)	Capital Costs
Direct Reuse from Sherman	Grayson County Manufacturing	561	$6,553,000
Direct Reuse from Sherman	Grayson County Steam Electric Power	6,548	$15,784,000
Grayson County Water Supply Project (Sherman WTP)	Howe	102	See GTUA in Section 5C.1.
Grayson County Water Supply Project (Northwest WTP)	Tioga	477	See GTUA in Section 5C.1.
Total			**$22,337,000**



2010 Population: *120,877*

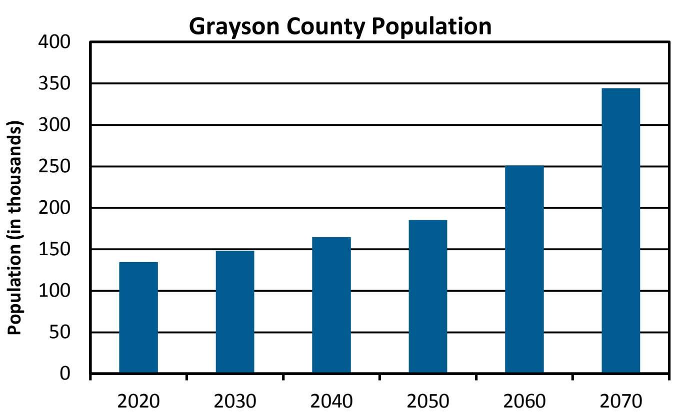
Projected 2070 Population: *344,127*

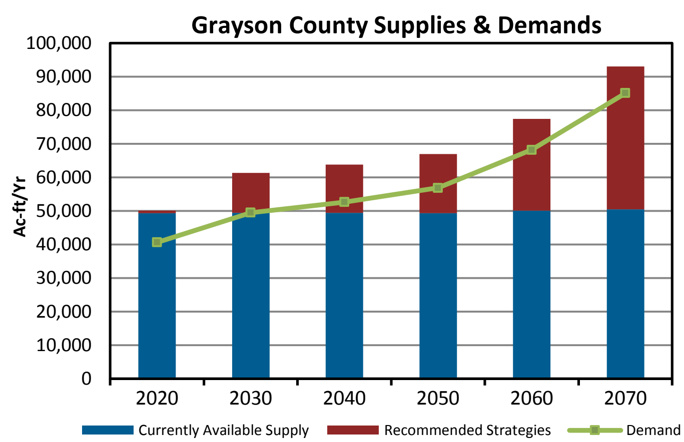
County Seat: *Sherman*

Economy: *Manufacturing, distribution and trade; tourism; mineral production.*

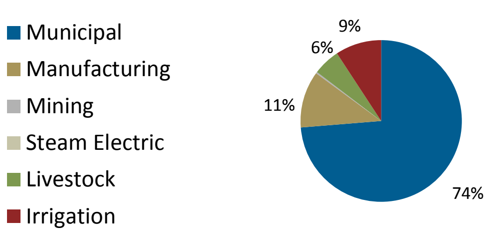
River Basin(s):

– Trinity (36%), Red (64%)



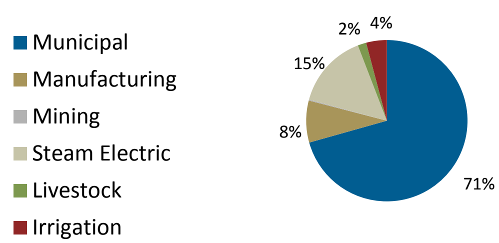


2010 Grayson County Historical Demand
(% of total)



Total= 23,154 acre-feet

2070 Grayson County Projected Demand
(% of total)



Total= 85,117 acre-feet

5D.9 Henderson County

Figure 5D.9 is a map of Henderson County. Henderson County is in the Neches and Trinity Valleys Groundwater Conservation District. The part of Henderson County in the Trinity Basin (the western part of the county) is in Region C, and the part in the Neches Basin is in the East Texas Region (Region I). There are four wholesale water providers that supply significant amounts of water in the Region C part of Henderson County:

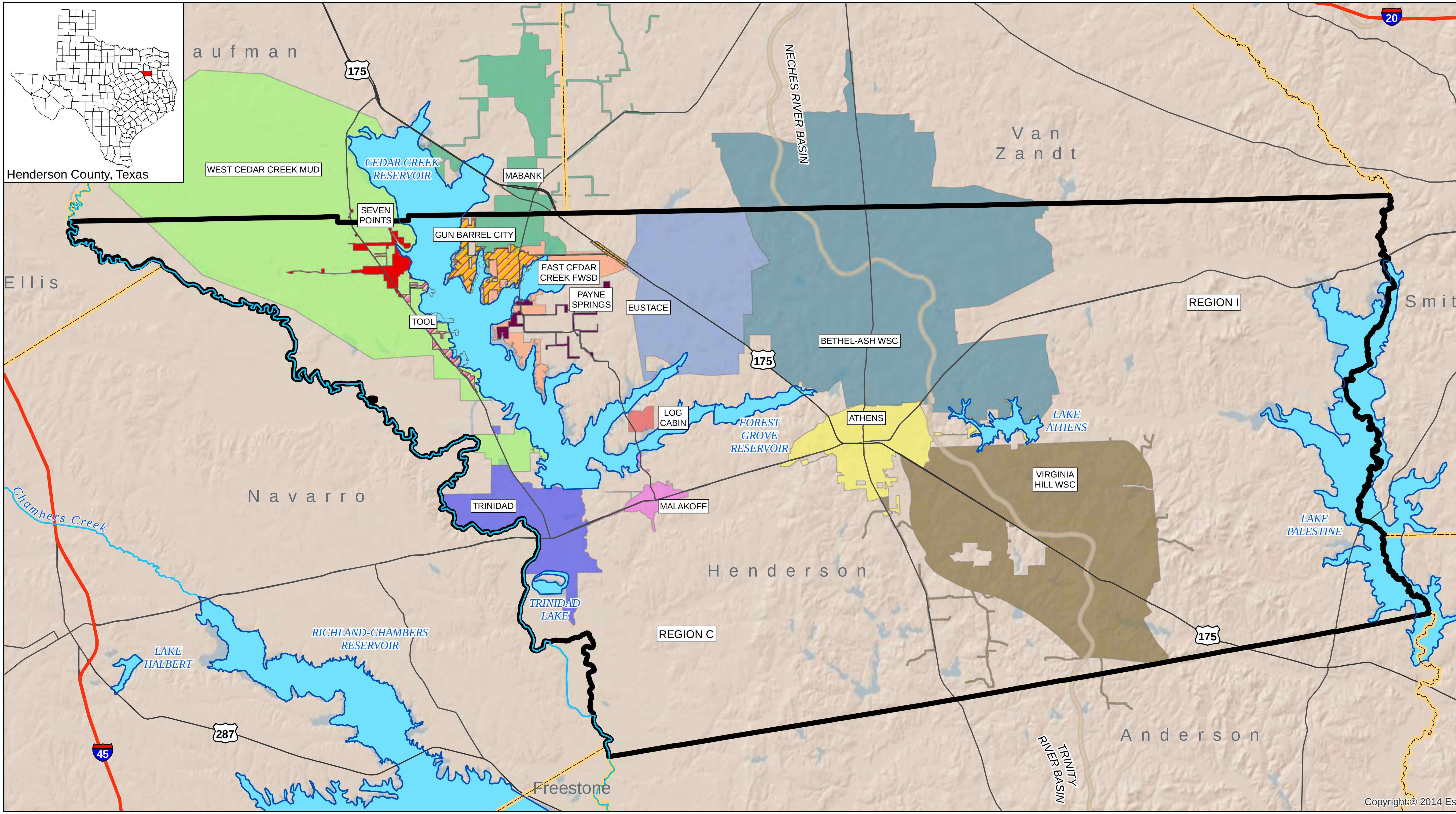
- Athens MWA provides treated water from Lake Athens to the City of Athens, which is located in Region C and Region I. Athens MWA also provides water for the Fish Hatchery in Region I (Henderson County Irrigation in the East Texas Region).
- East Cedar Creek Fresh Water Supply District provides retail service in western Henderson County, including all of Gun Barrel City and a portion of Payne Springs.
- West Cedar Creek Municipal Water District supplies retail service in western Henderson County and provides water to Kemp, Seven Points, and Tool.
- Tarrant Regional Water District (TRWD) provides raw water from Cedar Creek Lake to East Cedar Creek FWSD, West Cedar Creek MUD and other Henderson County water user groups.

The modeled available groundwater is a limiting factor for some suppliers. In the case of Athens MWA, their future plans include new wells in the Carrizo-Wilcox aquifer even though the volumes of that new supply is in excess of the modeled available groundwater. For that reason, it is being listed as an alternative management strategy, with Athens MWA and their customers having an unmet need in the later decades of the planning period.

A number of water user groups rely on the Carrizo-Wilcox and other aquifers and will continue to do so in the future. Water user groups that will obtain additional water from sources other than the wholesale water providers include the following:

- Bethel-Ash WSC is partially located in Region C, the North East Texas Region (Region D), and the East Texas Region (Region I). The North East Texas and East Texas Region plans address the needs of the portion of Bethel-Ash WSC that falls in those regions.
- Eustace and Payne Springs will use additional water from the Carrizo-Wilcox aquifer.

Water management strategies for Henderson County water user groups are discussed below (in alphabetical order). Table 5D.225 shows the estimated capital costs for the Henderson County water management strategies not associated with the wholesale water providers, and Table 5D.226 is a summary of the costs by category. Table 5D.226 is followed by a Henderson County summary.



FREESE AND NICHOLS

Project No: NTD11336

Service Area
County Boundary
Henderson County Boundary
River Basin Divide
River
Reservoir

N E S W

1 inch = 4 miles

0 2 4 8

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Henderson County, Texas

Figure 5D.9

Athens

The City of Athens is located in central Henderson County, and its population of about 12,800 is divided between the Trinity River Basin (Region C) and the Neches River Basin (the East Texas Region). Athens purchases treated water from the Athens Municipal Water Authority (a wholesale water provider that treats water from Lake Athens) and uses groundwater from the Carrizo-Wilcox aquifer. Water management strategies for Athens include conservation and additional water from Athens MWA. Athens MWA will have a shortage in later decades of the planning period and this shortage is applied to their customers, including the city of Athens. Table 5D.208 shows the projected population and demand, the current supplies, and the water management strategies for Athens. Plans for Athens MWA, which provides most of Athens' water supply, are discussed in Section 5C.2.

Table 5D.208
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Athens (Total of Region C and Region I)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**14,562**	**16,252**	**17,661**	**19,520**	**33,353**	**50,372**
Projected Water Demand						
Municipal Demand	2,973	3,244	3,473	3,809	6,484	9,782
Henderson County Manufacturing	345	356	368	380	391	403
Total Projected Demand	***3,318***	***3,600***	***3,841***	***4,189***	***6,875***	***10,185***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	845	845	845	845	845	845
Athens MWA (for Athens)	2,128	2,381	2,472	2,603	3,461	3,979
Athens MWA (for Manufacturing)	345	353	346	334	240	179
Total Current Supplies	***3,318***	***3,578***	***3,662***	***3,782***	***4,546***	***5,003***
Need (Demand - Current Supply)	***0***	***22***	***179***	***407***	***2,329***	***5,182***
Water Management Strategies						
Water Conservation	59	98	119	144	277	457
Additional Water from Athens MWA	1,254	1,330	1,391	1,469	1,878	2,140
Total Water Management Strategies	***1,313***	***1,428***	***1,510***	***1,613***	***2,155***	***2,597***
Reserve (Shortage)	**1,313**	**1,406**	**1,331**	**1,206**	**-174**	**-2,585**

Bethel-Ash Water Supply Corporation

Bethel-Ash WSC provides water for about 6,000 people in Henderson County (Region C and the East Texas Region) and in Van Zandt County (the North East Texas Region). Table 5D.209 shows the projected population and demand, the current supplies, and the water management strategies for the portion of Bethel-Ash WSC located in Region C. The Region I and Region D plan include strategies for the portion of Bethel-Ash WSC in those regions. The current supply for the WSC in Region C is the Carrizo-Wilcox aquifer, and the only water management strategy in Region C is conservation.

Table 5D.209
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Bethel-Ash WSC (Region C Only)

(Values in Ac-Ft/Yr)	**Projected Population and Demand**					
	2,138	**2,410**	**2,637**	**2,937**	**3,196**	**3,447**
Projected Region C Population						
Projected Water Demand	218	237	254	280	303	327
Municipal Demand	***218***	***237***	***254***	***280***	***303***	***327***
Total Projected Region C Demand						
Currently Available Water Supplies	327	327	327	327	327	327
Carrizo-Wilcox Aquifer	***327***	***327***	***327***	***327***	***327***	***327***
Total Current Supplies						
	0	***0***	***0***	***0***	***0***	***0***
Need (Demand - Current Supply)						
Water Management Strategies						
Water Conservation	2	3	3	4	5	7
Total Water Management Strategies	***2***	***3***	***3***	***4***	***5***	***7***
Reserve (Shortage)	**111**	**93**	**76**	**51**	**29**	**7**

East Cedar Creek Fresh Water Supply District

East Cedar Creek FWSD supplies water to approximately 8,200 retail customers on the east side of Cedar Creek Lake in Henderson County, including retail customers in Gun Barrel City and Payne Springs. The District is a wholesale water provider, and its plans are discussed in Section 5C.2.

Eustace

Eustace is a city of about 1,100 people located in northern Henderson County. The city's current supply is groundwater from the Carrizo-Wilcox aquifer, and conservation and new wells in the Carrizo-Wilcox aquifer are the only water management strategies. Table 5D.210 shows the projected population and demand, the current supplies, and the water management strategies for Eustace.

Table 5D.210
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Eustace

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,100**	**1,200**	**1,300**	**1,919**	**2,500**	**3,000**
Projected Water Demand						
Municipal Demand	119	125	132	191	248	297
Total Projected Demand	***119***	***125***	***132***	***191***	***248***	***297***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	194	194	194	194	194	194
Total Current Supplies	***194***	***194***	***194***	***194***	***194***	***194***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***54***	***103***
Water Management Strategies						
Water Conservation	1	1	1	3	4	6
New Wells in Carrizo-Wilcox	103	103	103	103	103	103
Total Water Management Strategies	***104***	***104***	***104***	***106***	***107***	***109***
Reserve (Shortage)	**179**	**173**	**166**	**109**	**53**	**6**

Gun Barrel City

Gun Barrel City is located on the east shore of Cedar Creek Lake, in northern Henderson County, and has a population of about 5,700. East Cedar Creek FWSD provides retail water service in Gun Barrel City, using raw water provided by TRWD. Table 5D.211 shows the projected population and demand, the current supplies, and the water management strategies for Gun Barrel City.

Table 5D.211
Projected Population and Demand, Current Supplies, and Water Management Strategies for Gun Barrel City

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (In City Only)	**6,000**	**6,500**	**7,000**	**8,211**	**12,500**	**20,000**
Projected Water Demand						
Municipal Demand	944	996	1,053	1,222	1,852	2,957
Total Projected Demand	***944***	***996***	***1,053***	***1,222***	***1,852***	***2,957***
Currently Available Water Supplies						
TRWD through East Cedar Creek Freshwater Supply District	620	611	575	594	691	794

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***620***	***611***	***575***	***594***	***691***	***794***
Need (Demand - Current Supply)	***324***	***385***	***478***	***628***	***1,161***	***2,163***
Water Management Strategies						
Water Conservation	8	11	11	16	31	59
Additional East Cedar Creek FWSD	316	374	467	612	1,130	2,104
Total Water Management Strategies	***324***	***385***	***478***	***628***	***1,161***	***2,163***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Henderson County Irrigation (Region C Only)

Table 5D.212 shows the projected demand, the current supplies, and the water management strategies for Henderson County Irrigation in Region C (the portion in the Trinity River Basin). As shown in Table 5D.212, there is no projected demand for irrigation in Henderson County in Region C, but there is supply available from local supplies, groundwater (Carrizo-Wilcox aquifer), and direct reuse. There are no water management strategies for this water user group.

Table 5D.212
Projected Demand, Current Supplies, and Water Management Strategies for Henderson County Irrigation (Region C Only)

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand-Region C	**0**	**0**	**0**	**0**	**0**	**0**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	50	50	50	50	50	50
Direct reuse	32	32	32	32	32	32
Local supplies	415	415	415	415	415	415
Total Current Supplies	***497***	***497***	***497***	***497***	***497***	***497***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**497**	**497**	**497**	**497**	**497**	**497**

Henderson County Livestock (Region C Only)

Table 5D.213 shows the projected demand, current supplies, and water management strategies for Henderson County Livestock in Region C (the portion in the Trinity River Basin). The current supplies are local surface water supplies and groundwater (Carrizo-Wilcox and Queen City aquifers). These sources are sufficient to meet projected demands, and there are no water management strategies.

Table 5D.213
Projected Demand, Current Supplies, and Water Management Strategies for Henderson County Livestock (Region C Only)

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand in Region C	**490**	**490**	**490**	**490**	**490**	**490**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	13	13	13	13	13	13
Queen City Aquifer	500	500	500	500	500	500
Local Supplies	341	341	341	341	341	341
Total Current Supplies	***854***	***854***	***854***	***854***	***854***	***854***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**364**	**364**	**364**	**364**	**364**	**364**

Henderson County Manufacturing (Region C Only)

Table 5D.214 shows the projected demand, the current supplies, and the water management strategies for Henderson County Manufacturing in Region C (the portion in the Trinity River Basin). Current supplies include groundwater (Carrizo-Wilcox aquifer, directly and through Malakoff) and water from Athens (from groundwater and from Lake Athens via Athens MWA). Additional supply from Athens is the water management strategy for this water user group. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5D.214
Projected Demand, Current Supplies, and Water Management Strategies for Henderson County Manufacturing (Region C Only)

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand in Region C	**575**	**594**	**613**	**633**	**652**	**671**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	396	396	396	396	396	396
Carrizo-Wilcox Aquifer (through Malakoff)	6	6	6	6	7	7
Athens MWA (through Athens)	345	353	346	334	240	179
Total Current Supplies	***747***	***755***	***748***	***736***	***643***	***582***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***9***	***89***
Water Management Strategies						
Additional Water from Athens WMA (through Athens)	175	172	171	167	122	92
Total Water Management Strategies	***175***	***172***	***171***	***167***	***122***	***92***
Reserve (Shortage)	**347**	**333**	**306**	**270**	**113**	**3**

Henderson County Mining (Region C Only)

Table 5D.215 shows the projected demand, the current supplies, and the water management strategies for Henderson County Mining in Region C (the portion in the Trinity River Basin). The current supply is from TRWD and groundwater (Carrizo-Wilcox aquifer). The only water management strategy for this water user group is additional supply from TRWD. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5D.215
Projected Demand, Current Supplies, and Water Management Strategies for Henderson County Mining (Region C Only)

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand in Region C	**607**	**607**	**607**	**607**	**607**	**607**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	425	425	425	425	425	425
Tarrant Regional Water District	182	166	146	129	115	103

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***607***	***591***	***571***	***554***	***540***	***528***
Need (Demand - Current Supply)	***0***	***16***	***36***	***53***	***67***	***79***
Water Management Strategies						
Additional TRWD	0	16	36	53	67	79
Total Water Management Strategies	***0***	***16***	***36***	***53***	***67***	***79***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Henderson County Other (Region C Only)

Henderson County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Henderson County Other in Region C supply about 3,000 people and receive their water supply from TRWD (direct and through Mabank) and groundwater (Carrizo-Wilcox aquifer). Water management strategies for these entities include conservation and additional water from TRWD. Table 5D.216 shows the projected population and demand, the current supplies, and the water management strategies for Henderson County Other.

Table 5D.216
Projected Population and Demand, Current Supplies, and Water Management Strategies for Henderson County Other (Region C Only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population in Region C	**3,424**	**2,700**	**2,623**	**2,319**	**2,058**	**1,807**
Projected Water Demand - Region C						
Municipal Demand	314	233	215	189	167	147
Total Projected Water Demand	***314***	***233***	***215***	***189***	***167***	***147***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	75	75	75	75	75	75
Tarrant Regional WD (direct & thru Mabank)	239	144	113	81	58	41
Total Current Supplies	***314***	***219***	***188***	***156***	***133***	***116***
Need (Demand - Current Supply)	***0***	***14***	***27***	***33***	***34***	***31***
Water Management Strategies						
Water Conservation	3	3	2	3	3	3
Additional TRWD	0	11	25	30	31	28
Total Water Management Strategies	***3***	***14***	***27***	***33***	***34***	***31***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Henderson County Steam Electric Power (Region C Only)

Table 5D.217 shows the projected demand, the current supplies, and the water management strategies for Henderson County Steam Electric Power in Region C (the portion in the Trinity River Basin). The current supply for this water user group is Lake Trinidad. The water management strategy is water from TRWD (Cedar Creek Lake). Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.217
Projected Demand, Current Supplies, and Water Management Strategies for Henderson County Steam Electric Power (Region C Only)

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand - Region C	**4,000**	**7,000**	**8,000**	**9,000**	**10,000**	**11,000**
Currently Available Water Supplies						
Lake Trinidad	3,050	3,050	3,050	3,050	3,050	3,050
Total Current Supplies	***3,050***	***3,050***	***3,050***	***3,050***	***3,050***	***3,050***
Need (Demand - Current Supply)	***950***	***3,950***	***4,950***	***5,950***	***6,950***	***7,950***
Water Management Strategies						
Tarrant Regional Water District	4,500	4,500	4,950	5,950	6,950	7,950
Total Water Management Strategies	***4,500***	***4,500***	***4,950***	***5,950***	***6,950***	***7,950***
Reserve (Shortage)	**3,550**	**550**	**0**	**0**	**0**	**0**

Log Cabin

Log Cabin is a community of about 700 people located in western Henderson County. The city's current water supply is groundwater from the Carrizo-Wilcox aquifer, and the only water management strategy is conservation. Table 5D.218 shows the projected population and demand, the current supplies, and the water management strategies for Log Cabin.

Table 5D.218
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Log Cabin

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**777**	**834**	**882**	**946**	**1,000**	**1,054**
Projected Water Demand						
Municipal Demand	80	82	84	89	93	98

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Projected Demand	***80***	***82***	***84***	***89***	***93***	***98***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	98	98	98	98	98	98
Total Current Supplies	***98***	***98***	***98***	***98***	***98***	***98***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	1	2	2
Total Water Management Strategies	***1***	***1***	***1***	***1***	***2***	***2***
Reserve (Shortage)	**19**	**17**	**15**	**10**	**7**	**2**

Mabank

Mabank has a population of about 3,100 and is located in southeastern Kaufman County and northern Henderson County. Projected demands and water management strategies for Mabank are discussed under Kaufman County in Section 5D.11.

Malakoff

Malakoff is a city of about 2,300 people located in western Henderson County. The city provides a small amount of retail water supply to Henderson County Manufacturing. The city gets its water supply from the Carrizo-Wilcox aquifer and from purchasing raw water from TRWD. The water management strategies for Malakoff are conservation and additional water from TRWD. Table 5D.219 shows the projected population and demand, the current supplies, and the water management strategies for Malakoff.

Table 5D.219
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Malakoff

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,411**	**2,491**	**2,557**	**2,645**	**2,800**	**3,000**
Projected Water Demand						
Municipal Demand	272	270	268	272	287	307
Henderson County Manufacturing	6	6	6	6	7	7
Total Projected Demand	***278***	***276***	***274***	***278***	***294***	***314***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	243	243	243	243	242	242

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox Aquifer for Manufacturing	6	6	6	6	7	7
Tarrant Regional Water District	29	25	20	21	29	37
Total Current Supplies	***278***	***274***	***269***	***270***	***278***	***286***
Need (Demand - Current Supply)	***0***	***2***	***5***	***8***	***16***	***28***
Water Management Strategies						
Water Conservation	2	3	3	4	5	6
Additional TRWD	0	0	2	4	11	22
Total Water Management Strategies	***2***	***3***	***5***	***8***	***16***	***28***
Reserve (Shortage)	**2**	**1**	**0**	**0**	**0**	**0**

Payne Springs

Payne Springs has a population of about 770 and is located in northern Henderson County. The city gets its water supply from the Carrizo-Wilcox aquifer and the East Cedar Creek Fresh Water Supply District. The water management strategies for Payne Springs are conservation, new wells in the Carrizo-Wilcox aquifer, and additional water from ECCFWSD. Table 5D.220 shows the projected population and demand, the current supplies, and the water management strategies for Payne Springs.

Table 5D.220
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Payne Springs

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**877**	**977**	**1,060**	**1,170**	**1,300**	**1,600**
Projected Water Demand						
Municipal Demand	143	155	165	181	200	246
Total Projected Demand	***143***	***155***	***165***	***181***	***200***	***246***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	101	101	101	101	101	101
East Cedar Creek FWSD (TRWD sources)	47	48	45	44	37	33
Total Current Supplies	***148***	***149***	***146***	***145***	***138***	***134***
Need (Demand - Current Supply)	***0***	***6***	***19***	***36***	***62***	***112***
Water Management Strategies						
Water Conservation	1	2	2	2	3	5

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox Aquifer (new wells)	145	145	145	145	145	145
Additional ECCFWSD	23	27	35	44	60	85
Total Water Management Strategies	***169***	***174***	***182***	***191***	***208***	***235***
Reserve (Shortage)	**174**	**168**	**163**	**155**	**146**	**123**

Seven Points

Seven Points is a city with a population of about 1,500 located in northwestern Henderson County, with a small area in Kaufman County. Residents of Seven Points are provided retail water service by West Cedar Creek MUD, which treats raw water supplied by TRWD from Cedar Creek Lake. The water management strategies for Seven Points are conservation and additional water from West Cedar Creek MUD. Table 5D.221 shows the projected population and demand, the current supplies, and the water management strategies for Seven Points.

Table 5D.221
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Seven Points

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,605**	**1,881**	**2,162**	**2,737**	**3,238**	**3,784**
Projected Water Demand						
Municipal Demand	355	409	465	586	692	808
Total Projected Demand	***355***	***409***	***465***	***586***	***692***	***808***
Currently Available Water Supplies						
West Cedar Creek Municipal Utility District (TRWD)	310	318	322	353	311	270
Total Current Supplies	***310***	***318***	***322***	***353***	***311***	***270***
Need (Demand - Current Supply)	***45***	***91***	***143***	***233***	***381***	***538***
Water Management Strategies						
Water Conservation	7	11	14	20	25	32
Additional Water from WCCMUD	38	80	129	213	356	506
Total Water Management Strategies	***45***	***91***	***143***	***233***	***381***	***538***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Tool

Tool is a city of about 2,200 people in northwestern Henderson County. The water supply for the city is West Cedar Creek MUD, which treats raw water supplied by TRWD from Cedar Creek Lake. The water management strategies for Tool are conservation and additional water from West Cedar Creek MUD. Table 5D.222 shows the projected population and demand, the current supplies, and the water management strategies for Tool.

Table 5D.222
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Tool

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**2,438**	**2,618**	**2,769**	**2,968**	**4,500**	**6,000**
Projected Water Demand						
Municipal Demand	553	583	607	646	976	1,300
Total Projected Demand	***553***	***583***	***607***	***646***	***976***	***1,300***
Currently Available Water Supplies						
West Cedar Creek Municipal Utility District (TRWD)	483	453	420	390	439	434
Total Current Supplies	***483***	***453***	***420***	***390***	***439***	***434***
Need (Demand - Current Supply)	***70***	***130***	***187***	***256***	***537***	***866***
Water Management Strategies						
Water Conservation	10	15	18	22	36	52
Additional Water from WCCMUD	60	115	169	234	501	814
Total Water Management Strategies	***70***	***130***	***187***	***256***	***537***	***866***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Trinidad

Trinidad is a city of about 900 located in western Henderson County. The city gets its water supply from Trinidad City Lake, which is adequate to meet projected demands. The only water management strategy for Trinidad is conservation, and Table 5D.223 shows the projected population and demand, the current supplies, and the water management strategies for the city.

Table 5D.223
Projected Population and Demand, Current Supplies and Water Management Strategies for the City of Trinidad

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**886**	**886**	**886**	**886**	**1,000**	**1,200**
Projected Water Demand						
Municipal Demand	91	86	83	83	93	111
Total Projected Demand	***91***	***86***	***83***	***83***	***93***	***111***
Currently Available Water Supplies						
Trinidad City Lake	450	450	450	450	450	450
Total Current Supplies	***450***	***450***	***450***	***450***	***450***	***450***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	1	2	2
Total Water Management Strategies	***1***	***1***	***1***	***1***	***2***	***2***
Reserve (Shortage)	**360**	**365**	**368**	**368**	**359**	**341**

Virginia Hill Water Supply Corporation

Virginia Hill WSC serves about 3,700 people in southern Henderson County. This water user group is split between Regions C and I. The table below shows the population, demand, and supply for all of Virginia Hills WSC, including the parts in Regions C and I. The WSC gets its water supply from the Carrizo-Wilcox aquifer, and the supply is sufficient to meet the projected demand. The only water management strategy for Virginia Hill WSC is conservation. Table 5D.224 shows the projected population and demand, the current supplies, and the water management strategies for Virginia Hill WSC.

Table 5D.224
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Virginia Hill Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,526**	**2,898**	**3,208**	**3,617**	**4,000**	**4,500**
Projected Water Demand						
Municipal Demand	420	460	494	548	602	667
Total Projected Demand	***420***	***460***	***494***	***548***	***602***	***667***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Carrizo-Wilcox Aquifer for Region C portion	387	387	388	387	388	394
Carrizo-Wilcox Aquifer to Region I portions	280	280	279	280	279	273
Total Current Supplies	***667***	***667***	***667***	***667***	***667***	***667***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	3	4	6	8
Total Water Management Strategies	***2***	***3***	***3***	***4***	***6***	***8***
Reserve (Shortage)	**249**	**210**	**176**	**123**	**71**	**8**

West Cedar Creek Municipal Utility District

West Cedar Creek MUD supplies water to about 25,000 people in northwestern Henderson County and northwestern Kaufman County, including retail customers within its service area and in the cities of Kemp, Seven Points, and Tool. The District is a wholesale water provider, and its plans are discussed in Section 5C.2.

Costs for Henderson County Water User Groups (Region C Only)

Table 5D.225 shows the estimated capital costs for Region C Henderson County water management strategies not covered under the wholesale water providers. Table 5D.226 summarizes the costs by category and is followed by a summary for Region C in Henderson County. Costs for the part of Henderson County in the Neches Basin are covered in the East Texas Region (Region I) regional water plan.

Table 5D.225
Costs for Recommended Water Management Strategies for Henderson County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Athens*	Conservation	2020	457	$242,562	$3.28	$0.79	Q-10
	Additional Athens MWA	2020	2,140	$0	$2.50	$2.50	None
Bethel-Ash WSC*	Conservation	2020	7	$4,744	$0.61	$0.00	Q-10

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
East Cedar Creek FWSD	Conservation	2020	24	$28,785	$1.23	$0.00	Q-10
	Other measures	See East Cedar Creek FWSD in Section 5C.2.					
Eustace	Conservation	2020	6	$5,043	$1.30	$0.00	Q-10
	New well in Carrizo-Wilcox	2020	103	$912,400	$3.05	$0.78	Q-146
Gun Barrel City	Conservation	2020	59	$28,375	$0.68	$0.00	Q-10
	Additional East CC FWSD	2020	2,104	$0	$2.50	$2.50	None
Henderson County Other (Region C only)	Conservation	2020	3	$5,449	$0.47	$0.00	Q-10
	Additional TRWD	2040	31	$0	$0.97	$0.97	None
Log Cabin	Conservation	2020	2	$1,340	$0.34	$0.00	Q-10
Mabank*	Conservation	See Kaufman County.					
	Additional TRWD	See Kaufman County.					
	WTP Expansions	See Kaufman County.					
Malakoff	Conservation	2020	6	$18,817	$2.42	$0.00	Q-10
	Additional TRWD	2020	22	$0	$0.97	$0.97	None
Payne Springs	Conservation	2020	5	$2,203	$0.57	$0.00	Q-10
	Additional Wells (Carrizo-Wilcox)	2020	145	$892,000	$2.30	$0.71	Q-148
	Additional East CC FWSD	2020	85	$0	$2.50	$2.50	None
Seven Points	Conservation	2020	32	$8,550	$2.35	$1.01	Q-10
	Additional West CC MUD	2020	506	$0	$2.50	$2.50	None
Tool	Conservation	2020	52	$13,672	$2.47	$0.98	Q-10
	Additional West CC MUD	2020	814	$0	$2.50	$2.50	None
Trinidad	Conservation	2020	2	$4,211	$1.08	$0.00	Q-10
Virginia Hill WSC* (Region C and I portions)	Conservation	2020	8	$4,442	$0.57	$0.00	Q-10
West Cedar Creek MUD*	Conservation	See Kaufman County.					
	Other measures	See West Cedar Creek MUD in Section 5C.2.					
Henderson County Irrigation (Region C only)	None	N/A	0	$0	N/A	N/A	N/A

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Henderson County Livestock (Region C only)	None	N/A	0	$0	N/A	N/A	N/A
Henderson County Manufacturing (Region C only)	Conservation	2030	0	$0	$0.95	$0.95	Q-11
	Additional from Athens	2020	175	$0	$2.50	$2.50	None
Henderson County Mining (Region C only)	Additional TRWD	2030	79	$0	$0.97	$0.97	N/A
Henderson County Steam Electric (Region C only)	TRWD (Cedar Creek Lake)	2030	7,950	$19,951,000	$0.84	$0.20	Q-147

Notes: Water User Groups marked with an * extend into more than one county or into the Region I part of Henderson County.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.226
Summary of Recommended Water Management Strategies for Henderson County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	663	$368,193
Purchase from WWP	13,906	$19,951,000
Groundwater	248	$1,804,400
Total		**$22,123,593**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

HENDERSON COUNTY

2010 Population: *78,532*

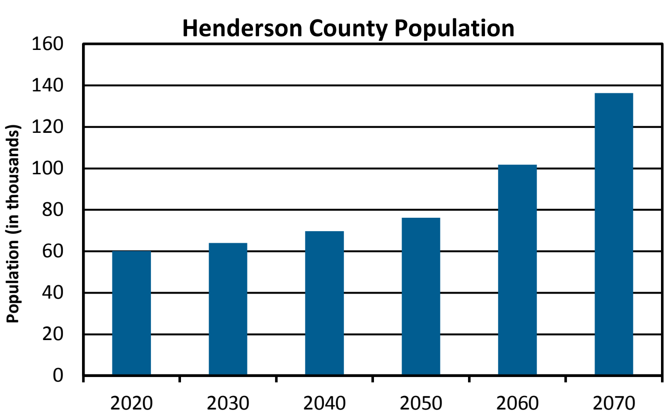
Projected 2070 Population: *136,269*

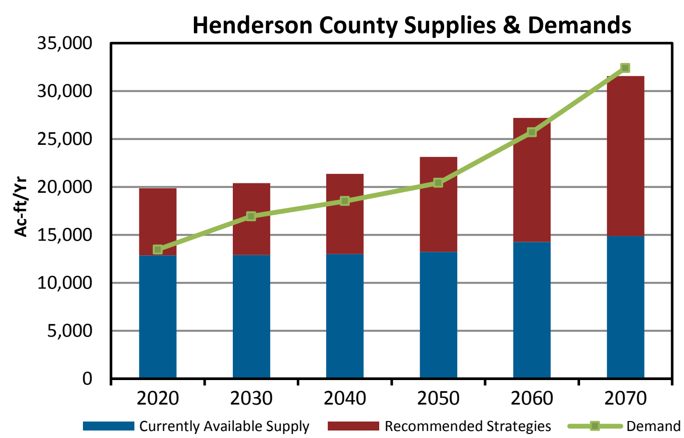
County Seat: *Athens*

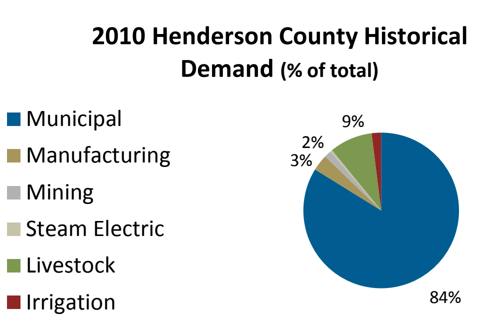
Economy: *Agribusiness; manufacturing; minerals; tourism.*

River Basin(s):

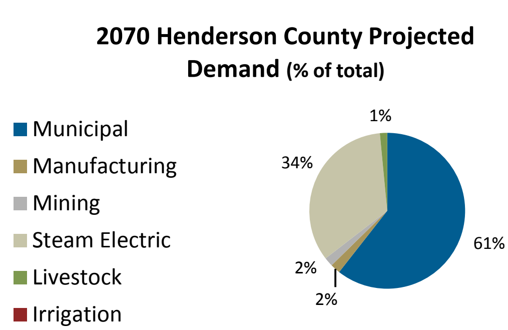
- Trinity (61%), Sabine (39%)







Total=14,344 acre-feet



Total= 32,402 acre-feet

5D.10 Jack County

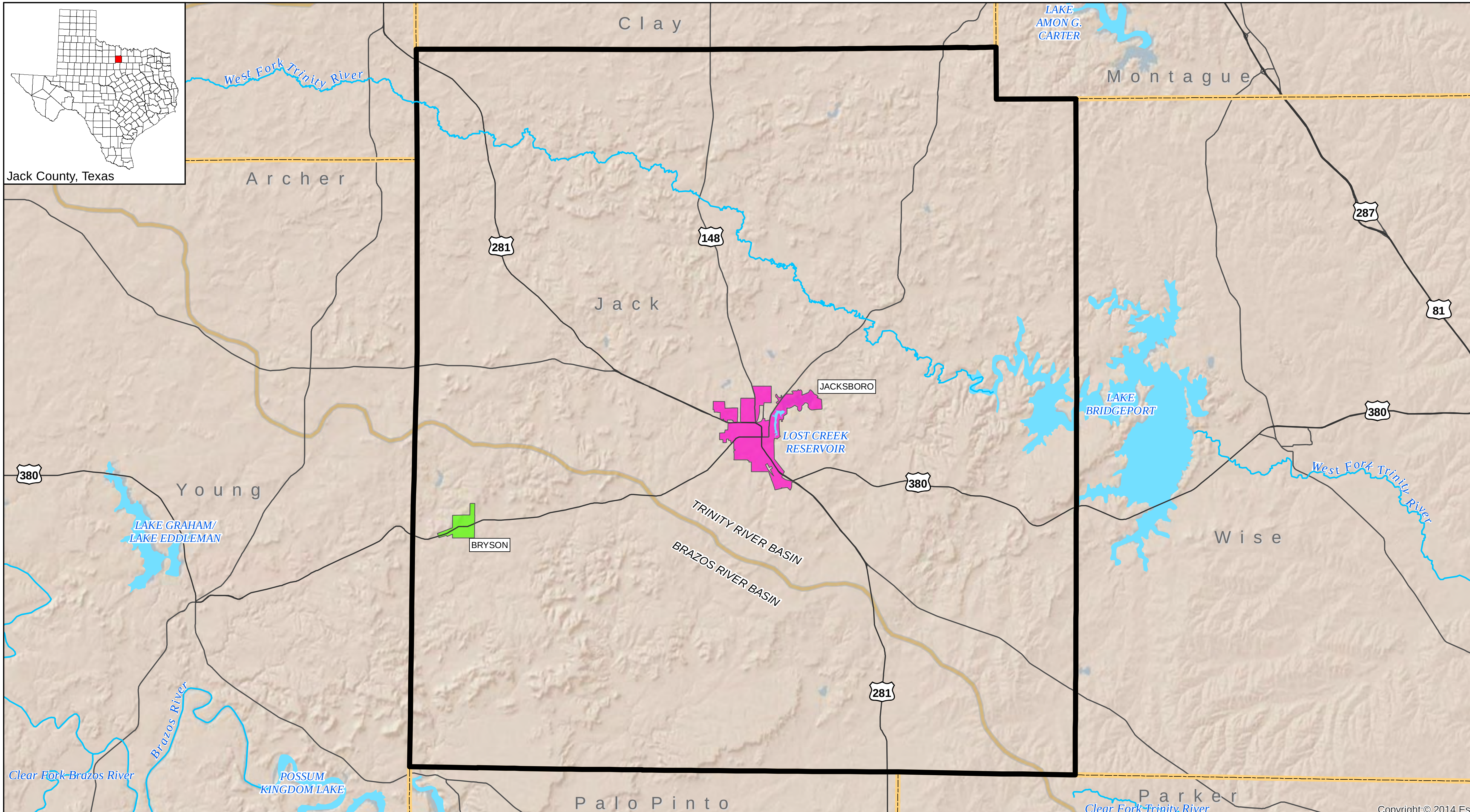
Figure 5D.10 is a map of Jack County. Three of the eight water user groups in this county will need additional supplies during the planning period. Water management strategies for Jack County water user groups are discussed on the following pages (in alphabetical order). Table 5D.235 shows the estimated capital costs for the Jack County water management strategies not associated with the wholesale water providers, and Table 5D.236 is a summary of the costs by category. Table 5D.236 is followed by a Jack County summary.

Bryson

Bryson is a city of about 540 people located in western Jack County. The current source of supply for Bryson is treated surface water from Graham, delivered through Fort Belknap WSC, and groundwater (Other aquifer). The only water management strategy for Bryson is water conservation. Table 5D.227 shows the projected population and demand, the current supplies, and the water management strategies for Bryson.

Table 5D.227
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Bryson

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**581**	**620**	**644**	**657**	**666**	**672**
Projected Water Demand						
Municipal Demand	80	82	83	84	85	85
Jack County Manufacturing	1	1	1	1	1	1
Total Projected Demand	***80***	***82***	***83***	***84***	***85***	***85***
Currently Available Water Supplies						
Graham (through Fort Belknap WSC)	46	46	46	46	46	46
Other Aquifer	50	50	50	50	50	50
Total Current Supplies	***96***	***96***	***96***	***96***	***96***	***96***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	1	1	2
Total Water Management Strategies	***1***	***1***	***1***	***1***	***1***	***2***
Reserve (Shortage)	**17**	**15**	**14**	**13**	**12**	**13**



FREESE AND NICHOLS

Project No: NTD11336

Service Area
County Boundary
Jack County Boundary
River Basin Divide
River
Reservoir

1 inch = 4 miles

0 2 4 8

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Jack County, Texas

Figure 5D.10

Jack County Irrigation

Table 5D.228 shows the projected demand, the current supplies, and the water management strategies for Jack County Irrigation. The available sources of supply are local supplies, indirect reuse, direct reuse, and groundwater (other aquifer). Current supplies are sufficient to meet future needs and the only water management strategy is conservation.

Table 5D.228
Projected Demand, Current Supplies,
and Water Management Strategies for Jack County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**101**	**101**	**101**	**101**	**101**	**101**
Currently Available Water Supplies						
Other Aquifer	55	55	55	55	55	55
Direct reuse	27	26	26	25	25	24
Local supplies	110	110	110	110	110	110
Total Current Supplies	***192***	***191***	***191***	***190***	***190***	***189***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	3	6	8	10	11
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**91**	**90**	**90**	**89**	**89**	**88**

Jack County Livestock

Table 5D.229 shows the projected demand, current supplies, and water management strategies for Jack County Livestock. The current supplies are local surface water supplies and groundwater (other aquifer). These sources are sufficient to meet future demands, and there are no water management strategies.

Table 5D.229
Projected Demand, Current Supplies, and Water
Management Strategies for Jack County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**932**	**932**	**932**	**932**	**932**	**932**
Currently Available Water Supplies						
Other Aquifer	130	130	130	130	130	130
Local Supplies	802	802	802	802	802	802

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***932***	***932***	***932***	***932***	***932***	***932***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Jack County Manufacturing

Table 5D.230 shows the projected demand and current supplies for Jack County Manufacturing. Current supplies are treated water from Jacksboro (originating from the Lost Creek Reservoir/Lake Jacksboro system) and water from Bryson, and they are sufficient to meet projected demands. There are no water management strategies for this water user group.

Table 5D.230
Projected Demand, Current Supplies, and Water Management Strategies for Jack County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**2**	**2**	**2**	**2**	**2**	**2**
Currently Available Water Supplies						
Bryson	1	1	1	1	1	1
Jacksboro (Lost Creek/Jacksboro system)	1	1	1	1	1	1
Total Current Supplies	***2***	***2***	***2***	***2***	***2***	***2***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Jack County Mining

Table 5D.231 shows the projected demand, the current supplies, and the water management strategies for Jack County Mining. Jack County Mining is supplied from local supplies and groundwater (other aquifer). In the past, the city of Jacksboro has sold potable water to mining users (mostly oil and gas), but prior to 2020 Jacksboro will discontinue sale of potable water and begin selling reuse water to mining users. The projected demands for Jack County Mining are very high relative to the previous Region C Plans, being roughly double the demand in the 2011 Region C Plan. Given the lack of available water supply in Jack County, it is anticipated that there will be an unmet need of 250 acre-feet per year for Mining demands. The water management strategies for this water user group are water from the conversion of Jacksboro's permitted indirect reuse from irrigation to mining and connection to TRWD system. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG. A reuse strategy has been recommended in lieu of a conservation strategy.

Table 5D.231
Projected Demand, Current Supplies, and Water Management Strategies for Jack County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**1,555**	**1,745**	**1,698**	**1,731**	**1,768**	**1,862**
Currently Available Water Supplies						
Other Aquifer	204	204	204	204	204	204
Local Supplies	370	370	370	370	370	370
Total Current Supplies	***574***	***574***	***574***	***574***	***574***	***574***
Need (Demand - Current Supply)	***981***	***1,171***	***1,124***	***1,157***	***1,194***	***1,288***
Water Management Strategies						
Jacksboro Indirect Reuse to Mining	330	342	348	351	356	359
TRWD	401	579	526	556	588	679
Total Water Management Strategies	***731***	***921***	***874***	***907***	***944***	***1,038***
Reserve (Shortage)	**-250**	**-250**	**-250**	**-250**	**-250**	**-250**

Jack County Other

Jack County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Jack County Other supply about 4,300 people and currently receive their water supply from groundwater (Other aquifer). Water management strategies for these entities include conservation and water from Jacksboro and Walnut Creek SUD. Walnut Creek SUD has specific plans to serve the town of Perrin, which is included as part of Jack County

Other. Table 5D.232 shows the projected population and demand, the current supplies, and the water management strategies for Jack County Other.

Table 5D.232
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Jack County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**4,307**	**4,598**	**4,778**	**4,873**	**4,943**	**4,988**
Projected Water Demand in Region C						
Municipal Demand	482	495	500	502	508	512
Total Projected Water Demand	***482***	***495***	***500***	***502***	***508***	***512***
Currently Available Water Supplies						
Other Aquifer	495	495	495	495	495	495
Total Current Supplies	***495***	***495***	***495***	***495***	***495***	***495***
Need (Demand - Current Supply)	***0***	***0***	***5***	***7***	***13***	***17***
Water Management Strategies						
Water Conservation	4	6	5	7	8	10
Jacksboro	7	7	7	7	7	7
Walnut Creek SUD	48	49	49	50	50	51
Total Water Management Strategies	***59***	***62***	***61***	***64***	***65***	***68***
Reserve (Shortage)	**72**	**62**	**56**	**57**	**52**	**51**

Jack County Steam Electric Power

Table 5D.233 shows the projected demand, the current supplies, and the water management strategies for Jack County Steam Electric Power. The current supply for this water user group is Tarrant Regional Water District (Lake Bridgeport). The water management strategy for Jack County Steam Electric Power is additional water from TRWD. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.233
Projected Demand, Current Supplies, and
Water Management Strategies for Jack County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**2,665**	**2,879**	**3,092**	**3,305**	**3,518**	**3,745**
Currently Available Water Supplies						
Tarrant Regional Water District	2,665	2,620	2,487	2,349	2,230	2,119
Total Current Supplies	***2,665***	***2,620***	***2,487***	***2,349***	***2,230***	***2,119***
Need (Demand - Current Supply)	***0***	***259***	***605***	***956***	***1,288***	***1,626***
Water Management Strategies						
Additional Tarrant Regional WD	0	259	605	956	1,288	1,626
Total Water Management Strategies	***0***	***259***	***605***	***956***	***1,288***	***1,626***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Jacksboro

Jacksboro, the county seat of Jack County, has a population of about 4,500 and is located in the center of the county. The city obtains its water supply from the Lost Creek Reservoir/Lake Jacksboro system, which it owns and operates. This source is sufficient to meet projected demands. Water conservation and Jacksboro indirect reuse to mining are the water management strategies. Table 5D.234 shows the projected population and demand, the current supplies, and the water management strategies for Jacksboro.

Table 5D.234
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Jacksboro

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,863**	**5,191**	**5,395**	**5,503**	**5,581**	**5,631**
Projected Water Demand						
Municipal Demand	681	706	719	725	734	740
Jack County Other	7	7	7	7	7	7
Jack County Manufacturing	1	1	1	1	1	1
Jack County Mining (Reuse Demand)	330	342	348	351	356	359
Total Projected Demand	***1,019***	***1,056***	***1,075***	***1,084***	***1,098***	***1,107***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Lost Creek/Jacksboro system (limited by WTP Capacity of 1.3 MGD)	734	734	734	734	734	734
Total Current Supplies	***734***	***734***	***734***	***734***	***734***	***734***
Need (Demand - Current Supply)	***285***	***322***	***341***	***350***	***364***	***373***
Water Management Strategies						
Water Conservation	6	8	7	10	12	15
Jacksboro Indirect Reuse to Mining	330	342	348	351	356	359
Total Water Management Strategies	***336***	***350***	***355***	***361***	***368***	***374***
Reserve (Shortage)	**51**	**28**	**14**	**11**	**4**	**1**

Costs for Jack County Water User Groups

Table 5D.235 shows the estimated capital costs for Jack County water management strategies not covered under the wholesale water providers. Table 5D.236 summarizes the costs by category and is followed by a summary for Jack County.

Table 5D.235
Costs for Recommended Water Management Strategies for Jack County
Not Covered Under Wholesale Water Providers

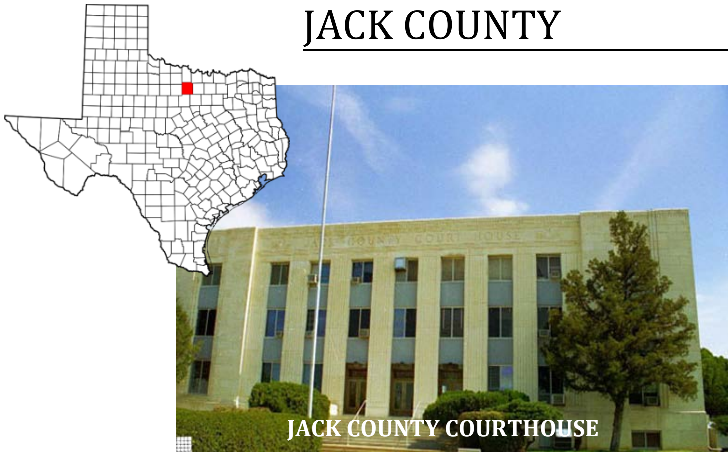
Water User Group	Strategy	Imple-mented by:	Quantity* (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Bryson	Conservation	2020	2	$4,352	$1.12	$0.00	Q-10
Jack County Other	Conservation	2020	10	$9,485	$0.61	$0.00	Q-10
	Jacksboro (Lost Creek/Lake Jacksboro)	2020	7	$1,893,000	$74.96	$5.56	Q-151
	Walnut Creek SUD	2020	51	$2,713,000	$15.40	$1.75	Q-152
Jacksboro	Conservation	2020	15	$16,571	$0.71	$0.00	Q-10
	Indirect Reuse to Mining	2020	See Jack County Mining Below.				
Jack County Irrigation	Conservation	2020	11	$0	$0.95	$0.95	Q-11
Jack County Livestock	None	N/A	N/A	N/A	N/A	N/A	N/A
Jack County Manufacturing	None	N/A	N/A	N/A	N/A	N/A	N/A

Water User Group	Strategy	Imple-mented by:	Quantity* (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Jack County Mining	Indirect reuse (Jacksboro)	2020	359	$0	$2.50	$2.50	None
	TRWD	2020	679	$0	$0.97	$0.97	None
Jack County Steam Electric	Additional TRWD	N/A	N/A	N/A	N/A	N/A	N/A

*Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.236
Summary of Recommended Water Management Strategies for Jack County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation	38	$30,408
Purchase from WWP	730	$2,713,000
Purchase from WUG	7	$1,893,000
Groundwater	359	$0
Total		**$4,636,408**



2010 Population: *9,044*

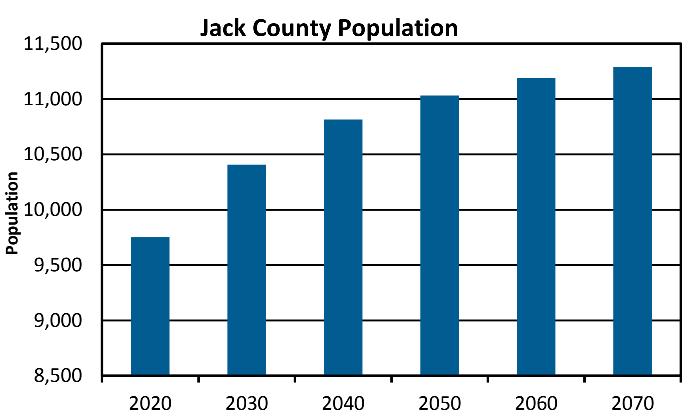
Projected 2070 Population: *11,291*

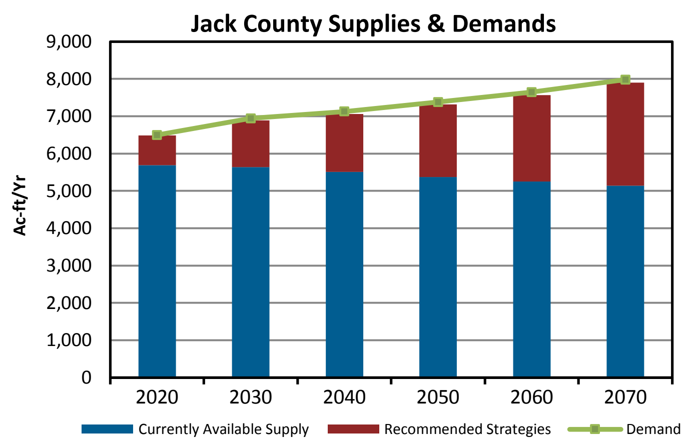
County Seat: *Jacksboro*

Economy: *Petroleum production, oil-field services, livestock, manufacturing tourism.*

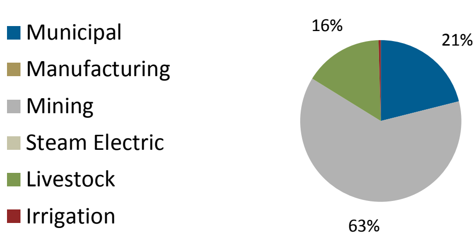
River Basin(s):

– Trinity (71%), Brazos (29%)



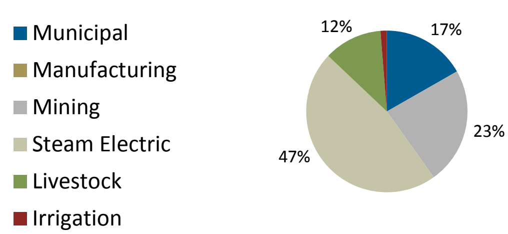


2010 Jack County Historical Demand
(% of total)



Total= 5,397 acre-feet

2070 Jack County Projected Demand
(% of total)



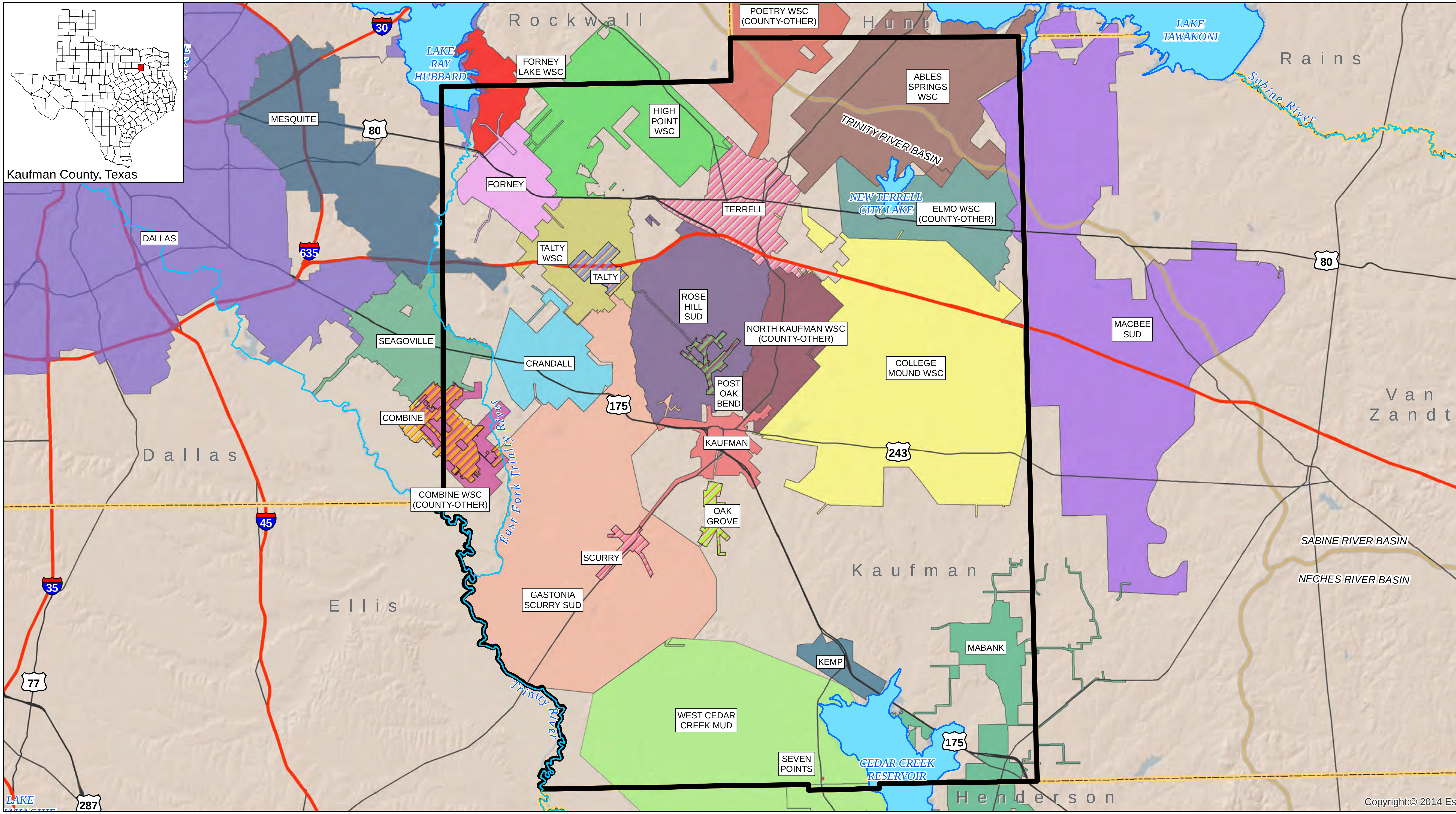
Total= 7,979 acre-feet

5D.11 Kaufman County

Figure 5D.11 is a map of Kaufman County. There is very little groundwater available in Kaufman County. The majority of the water user groups in Kaufman County rely on surface water provided by North Texas Municipal Water District (NTMWD), Tarrant Regional Water District (TRWD), and Dallas Water Utilities (DWU). NTMWD provides most of the water used in the county. There is also a substantial supply for steam electric demand from direct reuse of Garland's treated wastewater effluent by way of Forney. Water management strategies for Kaufman County water user groups are discussed on the following pages (in alphabetical order). Table 5D.260 shows the estimated capital costs for the Kaufman County water management strategies not associated with the wholesale water providers, and Table 5D.261 is a summary of the costs by category. Table 5D.261 is followed by a Kaufman County summary.

Ables Springs Water Supply Corporation

Ables Springs Water Supply Corporation supplies about 5,200 people in northeastern Kaufman County and southern Hunt County. (Hunt County is in the North East Texas Region, also called Region D.) The water supply for this WSC is treated water from North Texas Municipal Water District (NTMWD). Water management strategies for Ables Springs WSC are conservation and purchasing additional water from NTMWD. Table 5D.237 shows the projected population and demand, the current supplies, and the water management strategies for Ables Springs WSC.



FREESE AND NICHOLS

Project No: NTD11336

Service Area
County Boundary
Kaufman County Boundary
River Basin Divide
River
Reservoir

N
W E
S

1 inch = 4 miles

0 2 4 8

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Kaufman County, Texas

Figure 5D.11

Table 5D.237
Projected Population and Demand, Current Supplies, and Water Management Strategies for Ables Springs Water Supply Corporation (Regions C and D)

Regions C and D (Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population (Regions C&D)	**5,662**	**7,336**	**9,354**	**11,824**	**14,931**	**18,873**
Projected Water Demand (Regions C & D)						
Municipal Demand	383	494	630	796	1,006	1,271
Total Projected Water Demand	***383***	***494***	***630***	***796***	***1,006***	***1,271***
Currently Available Water Supplies						
North Texas Municipal Water District	353	379	446	530	629	735
Total Current Supplies	***353***	***379***	***446***	***530***	***629***	***735***
Need (Demand - Current Supply)	***30***	***115***	***184***	***266***	***377***	***536***
Water Management Strategies						
Water Conservation	3	4	5	8	12	17
Additional Water from NTMWD	27	111	179	258	365	519
Total Water Management Strategies	***30***	***115***	***184***	***266***	***377***	***536***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

College Mound Water Supply Corporation

College Mound WSC supplies about 9,000 people in eastern Kaufman County. The water supply for this WSC is purchased water from NTMWD, both directly from NTWMD and through Terrell. Water management strategies for College Mound WSC are conservation and purchasing additional water from NTMWD. Table 5D.238 shows the projected population and demand, the current supplies, and the water management strategies for College Mound WSC.

Table 5D.238
Projected Population and Demand, Current Supplies, and Water Management Strategies for College Mound Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**11,745**	**14,711**	**18,112**	**22,024**	**30,000**	**38,000**
Projected Water Demand						
Municipal Demand	790	989	1,218	1,481	2,017	2,554
Total Projected Water Demand	***790***	***989***	***1,218***	***1,481***	***2,017***	***2,554***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
NTMWD (direct and through Terrell)	728	758	860	986	1,258	1,475
Total Current Supplies	***728***	***758***	***860***	***986***	***1,258***	***1,475***
Need (Demand - Current Supply)	***62***	***231***	***358***	***495***	***759***	***1,079***
Water Management Strategies						
Water Conservation	7	11	12	20	34	51
Additional Water from Terrell/ NTMWD	55	220	346	475	725	1,028
Increase delivery capacity from Terrell	*0*	*0*	*0*	*0*	*508*	*1,028*
Total Water Management Strategies	***62***	***231***	***358***	***495***	***759***	***1,079***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Combine

Combine has a population of about 1,940 people and is located in southeast Dallas County and western Kaufman County. Combine WSC provides retail service within the city of Combine, and Combine WSC in turn gets its water from Dallas Water Utilities (DWU). (As of this round of planning, TWDB no longer considers Combine WSC to be a water user group but it is being recognized here for clarity.) Water conservation and additional water from Combine WSC (DWU) are the water management strategies for Combine. Table 5D.239 shows the projected population and demand, the current supplies, and the water management strategies for Combine.

Table 5D.239
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Combine

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,690**	**3,278**	**3,939**	**4,692**	**5,545**	**6,501**
Projected Water Demand						
Municipal Demand	308	361	423	498	588	687
Total Projected Water Demand	***308***	***361***	***423***	***498***	***588***	***687***
Currently Available Water Supplies						
Combine WSC (DWU)	183	188	189	189	169	152
Total Current Supplies	***183***	***188***	***189***	***189***	***169***	***152***
Need (Demand - Current Supply)	***125***	***173***	***234***	***309***	***419***	***535***
Water Management Strategies						
Water Conservation	3	4	4	7	10	14

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Combine WSC (DWU)	122	169	230	302	409	521
Total Water Management Strategies	***125***	***173***	***234***	***309***	***419***	***535***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Crandall

Crandall is a city of about 2,860 people in western Kaufman County. The city's water supply is purchased from NTMWD. Crandall plans to continue using NTMWD water. Water management strategies for Crandall are conservation and purchasing additional water from NTMWD. Table 5D.240 shows the projected population and demand, the current supplies, and the water management strategies for Crandall.

Table 5D.240
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Crandall

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,295**	**5,379**	**6,623**	**8,000**	**8,000**	**8,000**
Projected Water Demand						
Municipal Demand	779	955	1,162	1,397	1,396	1,395
Total Projected Demand	***779***	***955***	***1,162***	***1,397***	***1,396***	***1,395***
Currently Available Water Supplies						
NTWMD	605	605	605	605	605	605
Total Current Supplies	***605***	***605***	***605***	***605***	***605***	***605***
Need (Demand - Current Supply)	***174***	***350***	***557***	***792***	***791***	***790***
Water Management Strategies						
Water Conservation	14	25	35	47	51	56
Additional water from NTMWD	160	325	522	745	740	734
Total Water Management Strategies	***174***	***350***	***557***	***792***	***791***	***790***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Dallas

Dallas Water Utilities (DWU) is the water utility of the City of Dallas, which has a population of about 1,230,000. The City of Dallas is primarily in Dallas County but extends into Kaufman County (and several other counties). DWU is a wholesale water provider, and there is a detailed discussion of water supply plans for DWU in Section 5C.1.

Forney

Forney has a population of about 14,660 people and is located in northwestern Kaufman County. Forney is a wholesale water provider, and water supply plans for Forney are discussed in Section 5C.2.

Forney Lake Water Supply Corporation

Forney Lake WSC supplies water to about 4,324 people in northwestern Kaufman County and southwestern Rockwall County. The water supply for this WSC is purchased water from NTMWD. Water management strategies for Forney Lake WSC are conservation and purchasing additional water from NTMWD. Table 5D.241 shows the projected population and demand, the current supplies, and the water management strategies for Forney Lake WSC.

Table 5D.241
Projected Population and Demand, Current Supplies, and Water Management Strategies for Forney Lake Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**5,521**	**6,918**	**8,518**	**10,340**	**17,041**	**24,209**
Projected Water Demand						
Municipal Demand	896	1,108	1,355	1,639	2,694	3,824
Total Projected Demand	***896***	***1,108***	***1,355***	***1,639***	***2,694***	***3,824***
Currently Available Water Supplies						
NTWMD	826	849	957	1,091	1,681	2,208
Total Current Supplies	***826***	***849***	***957***	***1,091***	***1,681***	***2,208***
Need (Demand - Current Supply)	***70***	***259***	***398***	***548***	***1,013***	***1,616***
Water Management Strategies						
Water Conservation	16	28	41	55	99	153
Additional Water from NTMWD	54	231	357	493	914	1,463
Total Water Management Strategies	***70***	***259***	***398***	***548***	***1,013***	***1,616***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Gastonia-Scurry Special Utility District

Gastonia-Scurry SUD supplies water to about 9,200 people in western Kaufman County, including retail customers in Scurry and a portion of Talty. The water supply for this SUD is purchased water from NTMWD. Water management strategies for Gastonia-Scurry SUD are conservation, purchasing additional water from NTMWD, and connecting to Seagoville (which purchases water from DWU). Table 5D.242 shows the projected population and demand, the current supplies, and the water management strategies for Gastonia-Scurry SUD.

Table 5D.242
Projected Population and Demand, Current Supplies, and Water Management Strategies for Gastonia-Scurry Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population						
Outside of Scurry	9,508	11,910	14,663	17,830	30,000	45,000
Scurry	850	1,050	1,250	1,919	2,700	6,000
Total Population Served	**10,358**	**12,960**	**15,913**	**19,749**	**32,700**	**51,000**
Projected Water Demand						
Municipal Demand (Outside of Scurry)	640	801	986	1,199	2,017	3,025
Demand in Scurry	59	71	85	129	182	404
Talty (33%)	101	124	152	185	256	425
Total Projected Demand	***800***	***996***	***1,223***	***1,513***	***2,455***	***3,854***
Currently Available Water Supplies						
NTWMD	554	584	669	772	903	708
NTWMD for Scurry	54	54	60	86	114	233
NTWMD for Talty	93	95	108	123	160	246
Total Current Supplies	***701***	***733***	***837***	***981***	***1,177***	***1,187***
Need (Demand - Current Supply)	***99***	***263***	***386***	***532***	***1,278***	***2,667***
Water Management Strategies						
Water Conservation GSSUD	5	9	10	16	34	61
Water Conservation Scurry	0	1	1	2	3	8
Water Conservation Talty	1	1	2	2	4	9
Add'l NTMWD for GSSUD	42	169	268	372	511	457
Add'l NTMWD for Scurry	5	16	24	41	65	163
Add'l NTMWD for Talty	7	28	42	60	92	170
Connect to Seagoville (DWU)	39	39	39	39	569	1,799
Total Water Management Strategies	***99***	***263***	***386***	***532***	***1,278***	***2,667***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

High Point Water Supply Corporation

High Point WSC supplies water to about 4,155 people in northwestern Kaufman County and southern Rockwall County. The water supplies for this WSC are purchased water from Forney and Terrell, both of which purchase treated water from NTWMD. Water management strategies for High Point WSC are conservation and purchasing additional water from Forney and Terrell, increasing contract amounts as appropriate. Table 5D.243 shows the projected population and demand, the current supplies, and the water management strategies for High Point WSC.

Table 5D.243
Projected Population and Demand, Current Supplies, and Water Management Strategies for High Point Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**5,255**	**6,585**	**8,108**	**9,847**	**15,716**	**20,831**
Projected Water Demand						
Municipal Demand	477	569	681	817	1,298	1,718
Total Projected Demand	***477***	***569***	***681***	***817***	***1,298***	***1,718***
Currently Available Water Supplies						
Forney (NTMWD)	220	218	240	272	405	496
Terrell (NTMWD)	141	141	141	141	141	141
Total Current Supplies	***361***	***359***	***382***	***413***	***546***	***637***
Need (Demand - Current Supply)	***116***	***210***	***299***	***404***	***752***	***1,081***
Water Management Strategies						
Water Conservation	4	6	7	11	22	34
Additional Water from Forney	17	64	97	132	233	346
Additional Water from Terrell (increase contract amount)	96	141	196	262	497	701
Total Water Management Strategies	***117***	***211***	***300***	***405***	***752***	***1,081***
Reserve (Shortage)	**1**	**1**	**1**	**1**	**0**	**0**

Kaufman

Kaufman is a city of about 6,700 people in central Kaufman County. Kaufman provides retail service to portions of Kaufman County Other outside the city. The city's water supply is purchased water from NTMWD. Water management strategies for Kaufman are conservation and additional water from NTMWD. Table 5D.244 shows the projected population and demand, the current supplies, and the water management strategies for Kaufman.

Table 5D.244
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Kaufman

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (In City Only)	**8,000**	**10,000**	**12,500**	**18,890**	**24,445**	**30,000**
Projected Water Demand						
Municipal Demand	990	1,184	1,442	2,151	2,777	3,406
Kaufman County Other	22	31	169	441	1,332	2,022
Total Projected Demand	***1,012***	***1,215***	***1,611***	***2,592***	***4,109***	***5,428***
Currently Available Water Supplies						
NTWMD	912	907	1,018	1,432	1,733	1,967
NTWMD for Kaufman Co Other	19	22	102	232	733	1,043
Total Current Supplies	***931***	***930***	***1,121***	***1,664***	***2,466***	***3,010***
Need (Demand - Current Supply)	***81***	***285***	***490***	***927***	***1,643***	***2,418***
Water Management Strategies						
Water Conservation	8	13	14	29	46	68
Additional Water from NTMWD	70	264	410	690	998	1,371
Add'l NTMWD for Kaufman Co Other	3	8	67	208	599	979
Total Water Management Strategies	***81***	***285***	***490***	***927***	***1,643***	***2,418***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Kaufman County Irrigation

Water supplies for Kaufman County Irrigation include purchased water from Tarrant Regional Water District (TRWD – Cedar Creek Lake), direct reuse, local supplies, and groundwater (Nacatoch aquifer). The water management strategy for Kaufman County Irrigation is purchasing additional raw water from TRWD. Table 5D.245 shows the projected demand, the current supplies, and the water management strategies for Kaufman County Irrigation.

Table 5D.245
Projected Demand, Current Supplies, and Water Management Strategies for Kaufman County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**179**	**179**	**179**	**179**	**179**	**179**
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Tarrant Regional WD (Cedar Creek)	425	387	342	302	269	240
Direct Reuse	547	650	758	758	758	758
Local Supplies	64	64	64	64	64	64
Nacatoch Aquifer	89	89	89	89	89	89
Total Current Supplies	***1,125***	***1,189***	***1,252***	***1,213***	***1,180***	***1,151***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Additional Water from TRWD	0	38	83	123	156	185
Total Water Management Strategies	***0***	***38***	***83***	***123***	***156***	***185***
Reserve (Shortage)	**946**	**1,049**	**1,157**	**1,157**	**1,157**	**1,157**

Kaufman County Livestock

The water supplies for Kaufman County Livestock are local surface water supplies and groundwater (Nacatoch aquifer). These supplies are sufficient and there are no water management strategies needed. Table 5D.246 shows the projected demand, current supplies, and water management strategies for Kaufman County Livestock.

Table 5D.246
Projected Demand, Current Supplies, and
Water Management Strategies for Kaufman County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,717**	**1,717**	**1,717**	**1,717**	**1,717**	**1,717**
Currently Available Water Supplies						
Nacatoch Aquifer	100	100	100	100	100	100
Local Supplies	1,622	1,622	1,622	1,622	1,622	1,622
Total Current Supplies	***1,722***	***1,722***	***1,722***	***1,722***	***1,722***	***1,722***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**5**	**5**	**5**	**5**	**5**	**5**

Kaufman County Manufacturing

The water supplies for Kaufman County Manufacturing are groundwater from the Trinity aquifer and purchased treated water from NTMWD through Forney, Kaufman, and Terrell. Water management strategies for this water user group are conservation and purchasing additional water from NTMWD through the same suppliers. Table 5D.247 shows the projected demand and current supplies for Kaufman County Manufacturing.

Table 5D.247
Projected Demand, Current Supplies, and Water Management Strategies for Kaufman County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**813**	**869**	**928**	**993**	**1,061**	**1,134**
Currently Available Water Supplies						
Trinity Aquifer	487	487	487	487	487	487
NTWMD (through Terrell, Forney, and Kaufman)	749	666	632	609	589	568
Total Current Supplies	***1,236***	***1,153***	***1,119***	***1,096***	***1,076***	***1,055***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***79***
Water Management Strategies						
Water Conservation	0	2	20	28	30	32
Additional water from NTMWD	64	201	276	356	442	534
Total Water Management Strategies	***64***	***203***	***296***	***384***	***472***	***566***
Reserve (Shortage)	**487**	**487**	**487**	**487**	**487**	**487**

Kaufman County Mining

The water supplies for Kaufman County Mining are local supplies and groundwater (Trinity aquifer). The water management strategies for Kaufman County Mining are new wells in the Trinity aquifer and connecting to and purchasing from NTWMD. Table 5D.248 shows the projected demand, the current supplies, and the water management strategies for Kaufman County Mining. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5D.248
Projected Demand, Current Supplies, and
Water Management Strategies for Kaufman County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**296**	**386**	**491**	**646**	**783**	**951**
Currently Available Water Supplies						
Local Supplies	86	86	86	86	86	86
Trinity Aquifer	350	350	350	350	350	350
Total Current Supplies	***436***	***436***	***436***	***436***	***436***	***436***
Need (Demand - Current Supply)	***0***	***0***	***55***	***210***	***347***	***515***
Water Management Strategies						
Trinity Aquifer New wells	0	0	344	344	344	344
Connect to and Purchase water from NTMWD	0	0	0	0	3	171
Total Water Management Strategies	***0***	***0***	***344***	***344***	***347***	***515***
Reserve (Shortage)	**140**	**50**	**289**	**134**	**0**	**0**

Kaufman County Other

Kaufman County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Kaufman County Other supply about 14,000 people but is expected to grow to 90,000. The water supplies for these entities are groundwater (Nacatoch and Woodbine aquifers), and purchased water from DWU, NTMWD, and TRWD. Water management strategies for these entities are conservation and purchasing additional water from DWU, NTMWD, and TRWD. Table 5D.249 shows the projected population and demand, the current supplies, and the water management strategies for Kaufman County Other.

Table 5D.249
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Kaufman County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**15,829**	**17,093**	**24,432**	**38,000**	**65,000**	**90,000**
Projected Water Demand						
Municipal Demand	1,742	1,835	2,565	3,949	6,730	9,310
Total Projected Water Demand	***1,742***	***1,835***	***2,565***	***3,949***	***6,730***	***9,310***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Nacatoch Aquifer	736	736	736	736	736	736
Woodbine Aquifer	200	200	200	200	200	200
DWU (through Combine WSC thru Seagoville)	156	144	172	224	288	309
North Texas Municipal Water District	313	298	599	1,123	2,450	3,408
Tarrant Regional Water District (thru Mabank)	183	194	201	179	143	114
Total Current Supplies	***1,588***	***1,572***	***1,908***	***2,461***	***3,817***	***4,767***
Need (Demand - Current Supply)	***155***	***263***	***657***	***1,488***	***2,913***	***4,543***
Water Management Strategies						
Water Conservation	15	21	26	53	112	186
Additional Water from DWU	94	116	198	347	690	1,043
Additional Water from NTMWD	47	106	382	976	1,928	3,067
Additional Water from TRWD (thru Mabank)	0	22	52	115	189	256
Water from TRWD w/ new delivery and treatment facilities	86	91	127	194	331	457
Total Water Management Strategies	***242***	***355***	***785***	***1,685***	***3,250***	***5,009***
Reserve (Shortage)	**87**	**92**	**128**	**197**	**337**	**466**

Kaufman County Steam Electric Power

The water supplies for Kaufman County Steam Electric Power are direct reuse from Garland through Forney and purchased, treated water from NTMWD. Water management strategies for this water user group include purchasing treated water from Forney (originating from NTMWD) and reuse from the Trinity River Authority. Table 5D.250 shows the projected demand, the current supplies, and the water management strategies for Kaufman County Steam Electric Power.

Table 5D.250
Projected Demand, Current Supplies, and Water Management Strategies for Kaufman County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**8,000**	**8,000**	**8,000**	**8,000**	**8,000**	**8,000**
Currently Available Water Supplies						
Reuse from Garland (through Forney)	8,979	8,979	8,979	8,979	8,979	8,979
NTMWD treated water (through Forney)	1,033	859	792	746	699	647
Total Current Supplies	***10,012***	***9,838***	***9,771***	***9,725***	***9,678***	***9,626***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Add'l NTMWD treated water	88	262	329	375	422	474
TRA Reuse	1,000	1,000	1,000	1,000	1,000	1,000
Total Water Management Strategies	***1,088***	***1,262***	***1,329***	***1,375***	***1,422***	***1,474***
Reserve (Shortage)	**3,100**	**3,100**	**3,100**	**3,100**	**3,100**	**3,100**

Kemp

Kemp is a city of 1,155 people located in southern Kaufman County. The city previously purchased and treated raw water from West Cedar Creek Municipal Utility District (WCCMUD) for its water supply, but the city no longer has its own treatment facility and purchases treated water from WCCMUD. Water management strategies for Kemp include conservation and purchasing additional treated water from WCCMUD. Table 5D.251 shows the projected population and demand, the current supplies, and the water management strategies for Kemp.

Table 5D.251
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Kemp

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**1,734**	**2,172**	**2,674**	**3,252**	**5,000**	**7,000**
Projected Water Demand						
Municipal Demand	308	376	456	551	845	1,182
Total Projected Demand	***308***	***376***	***456***	***551***	***845***	***1,182***
Currently Available Water Supplies						
West Cedar Creek Municipal Utility District (TRWD)	269	292	315	332	380	394
Total Current Supplies	***269***	***292***	***315***	***332***	***380***	***394***
Need (Demand - Current Supply)	***39***	***84***	***141***	***219***	***465***	***788***
Water Management Strategies						
Water Conservation	11	30	38	48	76	111
Additional Water from WCCMUD	28	54	103	171	389	677
Total Water Management Strategies	***39***	***84***	***141***	***219***	***465***	***788***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Mabank

Mabank has a population of about 3,035 and is located in southeastern Kaufman County and northern Henderson County. The city buys and treats raw water from TRWD for its water supply. The city supplies treated water to rural areas outside the city, including portions of Henderson, Kaufman, and Van Zandt County Other categories. Water management strategies for Mabank are conservation, purchasing additional water from TRWD, and water treatment plant expansions including any needed increase in delivery infrastructure from Cedar Creek Lake to the water treatment plant. Table 5D.252 shows the projected population and demand, the current supplies, and the water management strategies for Mabank.

Table 5D.252
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Mabank

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population (In-city only)	**3,950**	**4,600**	**5,250**	**7,396**	**11,000**	**16,000**
Projected Water Demand						
Municipal Demand	783	896	1,012	1,417	2,103	3,056
Customer Demand (Henderson, Kaufman, & Van Zandt County Other)	410	483	556	636	710	789
Total Projected Demand	***1,193***	***1,379***	***1,568***	***2,053***	***2,813***	***3,845***
Currently Available Water Supplies						
Tarrant Regional Water District, limited to WTP Capacity	783	805	805	862	908	946
TRWD for Customers, limited to WTP capacity	410	450	457	427	381	343
Total Current Supplies	***1,193***	***1,255***	***1,261***	***1,289***	***1,289***	***1,289***
Need (Demand - Current Supply)	***0***	***124***	***307***	***764***	***1,524***	***2,556***
Water Management Strategies						
Water Conservation	14	23	30	47	77	122
Additional Raw Water Needed from TRWD with treatment as below:	0	101	277	717	1,447	2,434
2 MGD WTP Expansion		*67*	*249*	*717*	*1,121*	*1,121*
3 MGD WTP Expansion					*326*	*1,313*
Increase delivery infrastructure from Cedar Creek Lake		*67*	*249*	*717*	*1,447*	*2,434*
Total Water Management Strategies	***14***	***124***	***307***	***764***	***1,524***	***2,556***
Reserve (Shortage)	**14**	**0**	**0**	**0**	**0**	**0**

MacBee Special Utility District

MacBee SUD supplies water to about 8,500 people in Van Zandt County, Hunt County, and a small part of northeastern Kaufman County. Most of the SUD's service area is in the North East Texas Region (Region D). MacBee SUD gets its water supply by treating raw water purchased from the Sabine River Authority (SRA) from Lake Tawakoni. The only water management strategy for Region C is conservation. Strategies for the North East Texas Region are addressed in that regional water plan. Table 5D.253 shows the projected population and demand, the current supplies, and the water management strategies for MacBee SUD in Region C.

Table 5D.253
Projected Population and Demand, Current Supplies, and Water Management Strategies for MacBee Special Utility District (Region C Only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population in Region C	**266**	**333**	**410**	**498**	**601**	**719**
Projected Water Demand in Region C						
Municipal Demand	18	23	28	34	41	49
Total Projected Demand in Region C	***18***	***23***	***28***	***34***	***41***	***49***
Currently Available Water Supplies						
Sabine River Authority (Region D)	18	23	28	34	41	49
Total Current Supplies	***18***	***23***	***28***	***34***	***41***	***49***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	0	0	1	1
Total Water Management Strategies	***0***	***0***	***0***	***0***	***1***	***1***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**1**	**1**

Mesquite

Mesquite is a city of about 140,000 people located in eastern Dallas County extending into and western Kaufman County. Mesquite's water supply is discussed under Dallas County in Section 5D.3.

Oak Grove

Oak Grove is a city of about 620 located in central Kaufman County. The city's water is purchased water from NTMWD through retail service by North Kaufman WSC (which is in the Kaufman County Other category and gets its NTMWD water through Kaufman and Terrell). Water management strategies for

Oak Grove are conservation and purchasing additional NTMWD water from North Kaufman WSC. Table 5D.254 shows the projected population and demand, the current supplies, and the water management strategies for Oak Grove.

Table 5D.254
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Oak Grove

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**800**	**1,000**	**1,200**	**1,850**	**2,500**	**5,000**
Projected Water Demand						
Municipal Demand	75	88	103	157	212	422
Total Projected Demand	***75***	***88***	***103***	***157***	***212***	***422***
Currently Available Water Supplies						
NTMWD (through North Kaufman WSC)	69	67	73	105	132	244
Total Current Supplies	***69***	***67***	***73***	***105***	***132***	***244***
Need (Demand - Current Supply)	***6***	***21***	***30***	***52***	***80***	***178***
Water Management Strategies						
Water Conservation	1	1	1	2	4	8
Additional NTMWD (through North Kaufman WSC)	5	20	29	50	76	170
Total Water Management Strategies	***6***	***21***	***30***	***52***	***80***	***178***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Post Oak Bend City

Post Oak Bend City has a population of about 650 people and is located in central Kaufman County. The city's water supply is purchased water from Rose Hill SUD (which purchases water from NTWMD). Water management strategies for Post Oak Bend City are conservation and purchasing additional NTMWD water from Rose Hill SUD. Table 5D.255 shows the projected population and demand, the current supplies, and the water management strategies for Post Oak Bend City.

Table 5D.255
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Post Oak Bend City

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**800**	**1,000**	**1,200**	**1,850**	**2,500**	**5,000**
Projected Water Demand						
Municipal Demand	93	113	134	205	276	550
Total Projected Demand	***93***	***113***	***134***	***205***	***276***	***550***
Currently Available Water Supplies						
Rose Hill SUD (NTMWD)	86	87	95	136	172	318
Total Current Supplies	***86***	***87***	***95***	***136***	***172***	***318***
Need (Demand - Current Supply)	***7***	***26***	***39***	***69***	***104***	***232***
Water Management Strategies						
Water Conservation	1	1	1	3	5	11
Additional Rose Hill SUD (NTWMD)	6	25	38	66	99	221
Total Water Management Strategies	***7***	***26***	***39***	***69***	***104***	***232***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rose Hill Special Utility District

Rose Hill SUD provides water to about 5,200 people in central and northern Kaufman County. Table 5D.256 shows the projected demand, current supplies, and water management strategies for Rose Hill SUD. The water supply for this water user group is purchased water from NTWMD. Water management strategies for Rose Hill SUD are conservation and purchasing additional water from NTWMD.

Table 5D.256
Projected Demand, Current Supplies,
and Water Management Strategies for Rose Hill SUD

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**5,278**	**6,611**	**8,139**	**9,897**	**13,000**	**20,000**
Projected Water Demand						
Municipal Demand	456	546	656	789	1,033	1,586
Post Oak Bend City	93	113	134	205	276	550
Total Projected Demand	***549***	***659***	***790***	***994***	***1,309***	***2,136***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
NTWMD	420	418	463	525	644	916
NTWMD (for Post Oak Bend City)	86	87	95	136	172	318
Total Current Supplies	***506***	***505***	***558***	***662***	***817***	***1,234***
Need (Demand - Current Supply)	***43***	***154***	***232***	***332***	***492***	***902***
Water Management Strategies						
Water Conservation	4	6	7	11	17	32
Water Conservation (Post Oak)	1	1	1	3	5	11
Additional Water from NTWMD	32	122	186	253	372	638
Add'l Water from NTWMD for Post Oak	6	25	38	66	99	221
Total Water Management Strategies	***43***	***154***	***232***	***332***	***492***	***902***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Scurry

Scurry is located in central Kaufman County and has a population of about 700. The city's water supply is purchased water from Gastonia-Scurry WSC. Water management strategies for Scurry are conservation and purchasing additional NTMWD water from Gastonia-Scurry WSC. Table 5D.257 shows the projected population and demand, the current supplies, and the water management strategies for Scurry.

Table 5D.257
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Scurry

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**850**	**1,050**	**1,250**	**1,919**	**2,700**	**6,000**
Projected Water Demand						
Municipal Demand	59	71	85	129	182	404
Total Projected Demand	***59***	***71***	***85***	***129***	***182***	***404***
Currently Available Water Supplies						
Gastonia-Scurry WSC (NTMWD)	54	54	60	86	114	233
Total Current Supplies	***54***	***54***	***60***	***86***	***114***	***233***
Need (Demand - Current Supply)	***5***	***17***	***25***	***43***	***68***	***171***
Water Management Strategies						
Water Conservation	0	1	1	2	3	8

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from Gastonia-Scurry WSC (NTMWD)	5	16	24	41	65	163
Total Water Management Strategies	***5***	***17***	***25***	***43***	***68***	***171***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Seagoville

Seagoville is a city of about 14,800 people located in southeastern Dallas County with some area in Kaufman County. Seagoville is a wholesale water provider, and there is a discussion of the city's water supply plans in Section 5C.2.

Seven Points

Seven Points is a city with a population of about 1,500 in northwestern Henderson County with a small population in Kaufman County. The water management strategies for Seven Points are discussed under Henderson County in Section 5D.9.

Talty

Talty is a city of about 1,535 located in western Kaufman County. The city's water supplies are purchased water from Gastonia-Scurry SUD and Talty WSC. Water management strategies for Talty are conservation and purchasing additional NTMWD water from Gastonia-Scurry SUD and Talty WSC. Table 5D.258 shows the projected population and demand, the current supplies, and the water management strategies for Talty.

Table 5D.258
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Talty

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,306**	**2,889**	**3,557**	**4,325**	**6,000**	**10,000**
Projected Water Demand						
Municipal Demand	305	377	462	560	775	1,289
Total Projected Demand	***305***	***377***	***462***	***560***	***775***	***1,289***
Currently Available Water Supplies						
North Texas Municipal Water District (through Talty WSC 67%)	188	194	219	250	324	499

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
North Texas Municipal Water District (through Gastonia-Scurry SUD 33%)	93	95	108	123	160	246
Total Current Supplies	***281***	***289***	***326***	***373***	***484***	***744***
Need (Demand - Current Supply)	***24***	***88***	***136***	***187***	***291***	***545***
Water Management Strategies						
Water Conservation	3	4	5	7	13	26
Add'l Water from Talty WSC (NTMWD)	14	56	88	121	187	347
Add'l Water from G-S SUD(NTMWD)	7	28	43	59	92	171
Total Water Management Strategies	***24***	***88***	***136***	***187***	***291***	***545***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Talty Water Supply Corporation

Talty WSC provides water to about 5,650 people in central and northern Kaufman County. The water supply for this water user group is purchased water from NTWMD. Water management strategies for Talty WSC are conservation and purchasing additional water from NTWMD. Table 5D.259 shows the projected demand, current supplies, and water management strategies for Talty WSC.

Table 5D.259
Projected Demand, Current Supplies,
and Water Management Strategies for Talty WSC

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (Outside City Only)	**9,663**	**11,103**	**12,902**	**18,121**	**23,000**	**30,000**
Projected Water Demand						
Municipal Demand	1,584	1,801	2,083	2,914	3,693	4,813
Talty (67%)	204	253	310	375	519	864
Total Projected Demand	***1,788***	***2,054***	***2,393***	***3,289***	***4,212***	***5,677***
Currently Available Water Supplies						
NTMWD	1,460	1,380	1,471	1,940	2,304	2,780
NTWMD (for Talty)	188	194	219	250	324	499
Total Current Supplies	***1,648***	***1,574***	***1,690***	***2,190***	***2,628***	***3,278***
Need (Demand - Current Supply)	***140***	***480***	***703***	***1,099***	***1,584***	***2,399***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation Talty WSC	29	47	62	97	135	193
Water Conservation Talty (67%)	2	3	3	5	9	17
Add'l NTWMD	95	374	551	877	1,254	1,841
Add'l NTWMD for Talty	14	56	88	121	187	347
Total Water Management Strategies	***140***	***480***	***703***	***1,100***	***1,585***	***2,399***
Reserve (Shortage)	**0**	**0**	**0**	**1**	**1**	**0**

Terrell

Terrell is a city of about 15,820 people located in northern Kaufman County. Terrell is a wholesale water provider, and there is a discussion of the city's water supply plans in Section 5C.2.

West Cedar Creek Municipal Utility District

West Cedar Creek MUD supplies water to about 17,700 people in northwestern Henderson County and southwestern Kaufman County, including retail customers in Seven Points and Tool. The District is a wholesale water provider, and its plans are discussed in Section 5C.2.

Costs for Kaufman County Water User Groups

Table 5D.260 shows the estimated capital costs for Kaufman County water management strategies not covered under the wholesale water providers. Table 5D.261 summarizes the costs by category and is followed by a summary for Kaufman County.

Table 5D.260
Costs for Recommended Water Management Strategies for Kaufman County
Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Ables Springs WSC*	Conservation	2020	17	$13,856	$1.19	$0.00	Q-10
	Additional NTMWD	2020	519	$0	$1.75	$1.75	None

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
College Mound WSC	Conservation	2020	51	$15,432	$0.57	$0.00	Q-10
	Additional Terrell	2020	1,028	$0	$2.50	$2.50	None
	Increase delivery from Terrell	*2020*	*1,028*	$5,348,000	$1.61	$0.27	Q-153
Combine*	Conservation	2020	14	$21,983	$1.88	$0.00	Q-10
	Additional DWU	2020	521	$0	$1.48	$1.48	None
Crandall	Conservation	2020	56	$20,209	$2.99	$1.21	Q-10
	Additional NTMWD	2020	745	$0	$1.75	$1.75	None
Forney	Conservation	2020	225	$308,348	$2.93	$0.00	Q-10
	Additional NTMWD	See Forney in Section 5C.					
Forney Lake WSC*	Conservation	2020	153	$44,705	$3.65	$1.22	Q-10
	Additional NTMWD	2020	1,463	$0	$1.75	$1.75	None
Gastonia-Scurry SUD	Conservation	2020	61	$12,199	$0.63	$0.00	Q-10
	Additional NTMWD	2020	511	$0	$1.75	$1.75	None
	Supply from Seagoville	2020	1,799	$0	$2.50	$2.50	None
	Connect to Seagoville (DWU)	*2020*	*1,799*	$4,577,500	$0.73	$0.08	Q-155
High Point WSC*	Conservation	2020	34	$9,661	$0.62	$0.00	Q-10
	Additional NTMWD	2020	1,047	$0	$1.75	$1.75	None
Kaufman	Conservation	2020	68	$12,755	$0.41	$0.00	Q-10
	Additional NTMWD	2020	1,371	$0	$1.75	$1.75	None
Kaufman County Other	Conservation	2020	186	$37,415	$0.64	$0.00	Q-10
	Additional NTMWD	2020	3,067	$0	$1.75	$1.75	None
	Additional Mabank	2030	256	$0	$2.50	$2.50	None
	Supply from TRWD	2020	457	$0	$0.97	$0.97	None
	0.8 MGD Water Treatment Plant for TRWD water	*2020*	*457*	$11,922,000	$10.49	$3.79	Q-149
	Additional DWU	2020	1,043	$0	$1.48	$1.48	None

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Kemp	Conservation	2020	111	$31,428	$11.52	$1.73	Q-10
	Additional WCCMUD	2020	677	$0	$2.50	$2.50	None
Mabank*	Conservation	2020	122	$48,679	$3.04	$1.04	Q-10
	Additional TRWD	2030	2,434	$0	$0.97	$0.97	None
	2 MGD WTP Expansion	*2030*	*1,121*	$8,905,000	$2.91	$0.87	Q-13
	3 MGD WTP Expansion	*2060*	*1,313*	$11,037,000	$3.08	$0.92	Q-13
	Increase delivery infrastructure from Cedar Creek Lake	*2060*	*2,434*	$262,000	$0.03	$0.01	Q-143
MacBee SUD*	Conservation	2020	1	$243	$0.00	$0.00	Q-10
	Additional SRA	See Region D plan for information					
Mesquite*	Conservation	See Dallas County.					
	Additional NTMWD	See Dallas County.					
Oak Grove	Conservation	2020	8	$1,272	$0.33	$0.00	Q-10
	Additional NTMWD	2020	170	$0	$1.75	$1.75	None
Post Oak Bend City	Conservation	2020	11	$1,726	$0.44	$0.00	Q-10
	Additional NTMWD	2020	221	$0	$1.75	$1.75	None
Rose Hill SUD	Conservation	2020	32	$22,139	$1.42	$0.00	Q-10
	Additional NTMWD	2020	638	$0	$1.75	$1.75	None
Scurry	Conservation	2020	8	$864	$0.00	$0.00	Q-10
	Additional NTMWD	2020	163	$0	$1.75	$1.75	None
Seagoville*	Conservation	See Dallas County.					
	Additional DWU	See Dallas County.					
Seven Points*	Conservation	See Henderson County.					
	Additional West CC MUD	See Henderson County.					
Talty	Conservation	2020	26	$3,079	$0.26	$0.00	Q-10
	Additional NTMWD	2020	347	$0	$1.75	$1.75	None

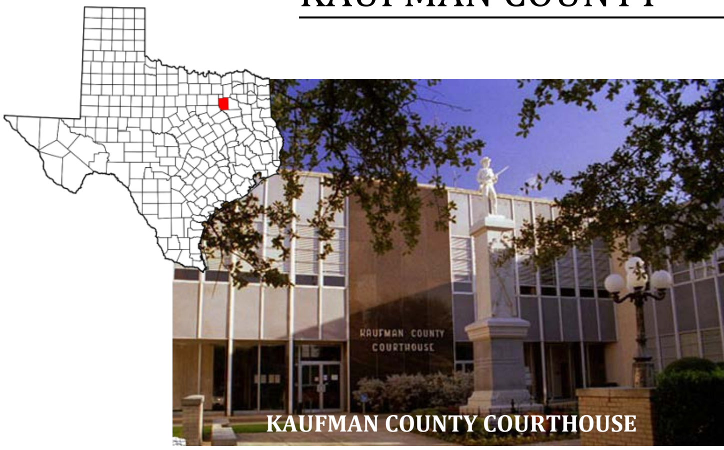
Talty WSC	Conservation	2020	193	$27,225	$3.05	$1.11	Q-10
	Additional NTMWD	2020	1,841	$0	$1.75	$1.75	None
Terrell	Conservation	2020	574	$132,163	$2.93	$0.74	Q-10
	Other measures	See Terrell in Section 5C.2.					
West Cedar Creek MUD*	Conservation	2020	67	$54,495	$1.27	$0.00	Q-10
	Other measures	See West Cedar Creek MUD in Section 5C.2.					
Kaufman Co Irrigation	Additional TRWD	2020	185	$0	$0.97	$0.97	None
Kaufman Co Livestock	None	N/A	N/A	N/A	N/A	N/A	N/A
Kaufman County Manufacturing	Conservation	2030	32	$0	$0.95	$0.95	Q-11
	Additional NTMWD	2020	534	$0	$0.68	$0.68	None
Kaufman County Mining	Trinity Aquifer New wells	2040	344	$484,000	$0.47	$0.11	Q-216
	Supply from NTWMD	2060	171	$0	$1.75	$1.75	None
	Connect to NTWMD	*2060*	*171*	$4,098,000	$7.11	$0.95	Q-156
Kaufman County Steam Electric	Additional Treated NTMWD (through Forney)	2020	474	$0	$1.75	$1.75	None
	TRA direct reuse	2020	1,000	See TRA in Section 5C			

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.261
Summary of Recommended Water Management Strategies for Kaufman County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	2,050	$819,876
Purchase from WWP	18,598	$0
Purchase from WUG	3,083	$0
Delivery infrastructure	*5,432*	$14,285,500
Treatment Plants	*2,891*	$31,864,000
Groundwater	344	$484,000
Reuse	1,000	$0
Total		**$47,453,376**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.



***2010 Population:** 103,350*

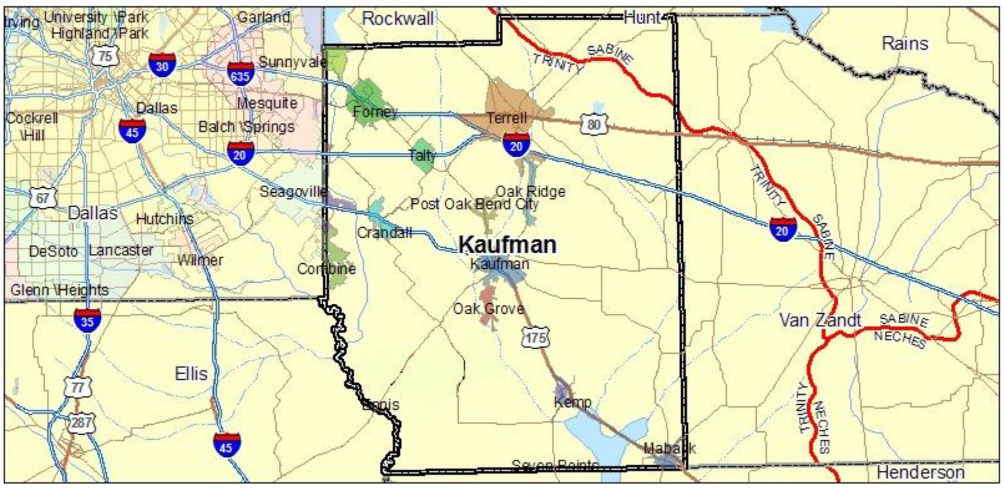
***Projected 2070 Population:** 571,840*

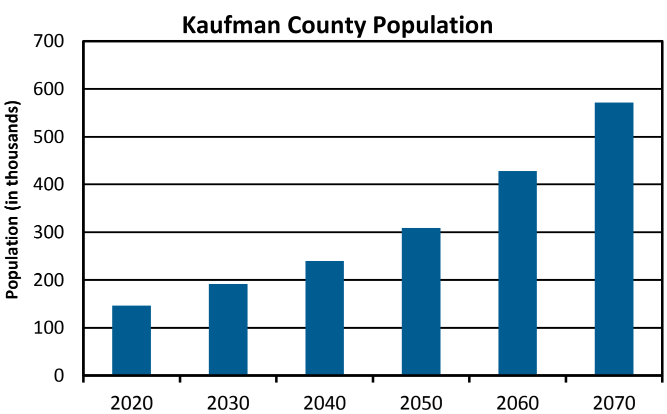
***County Seat:** Kaufman*

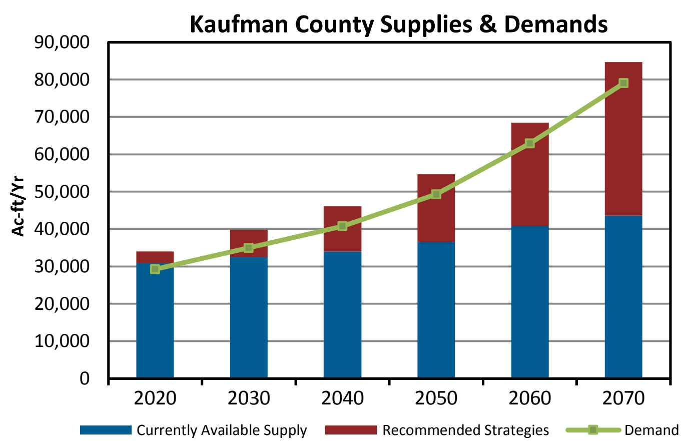
***Economy:** Manufacturing; government/services*

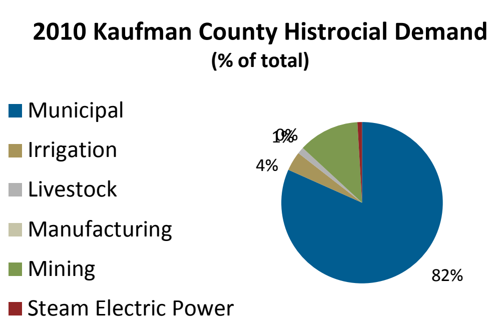
River Basin(s):

- Trinity (95%), Sabine (5%)

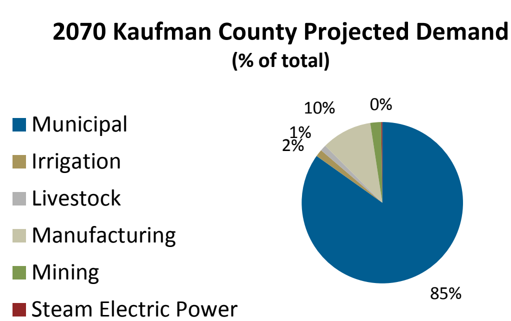








Total= 17,544 acre-feet



Total= 78,996 acre-feet

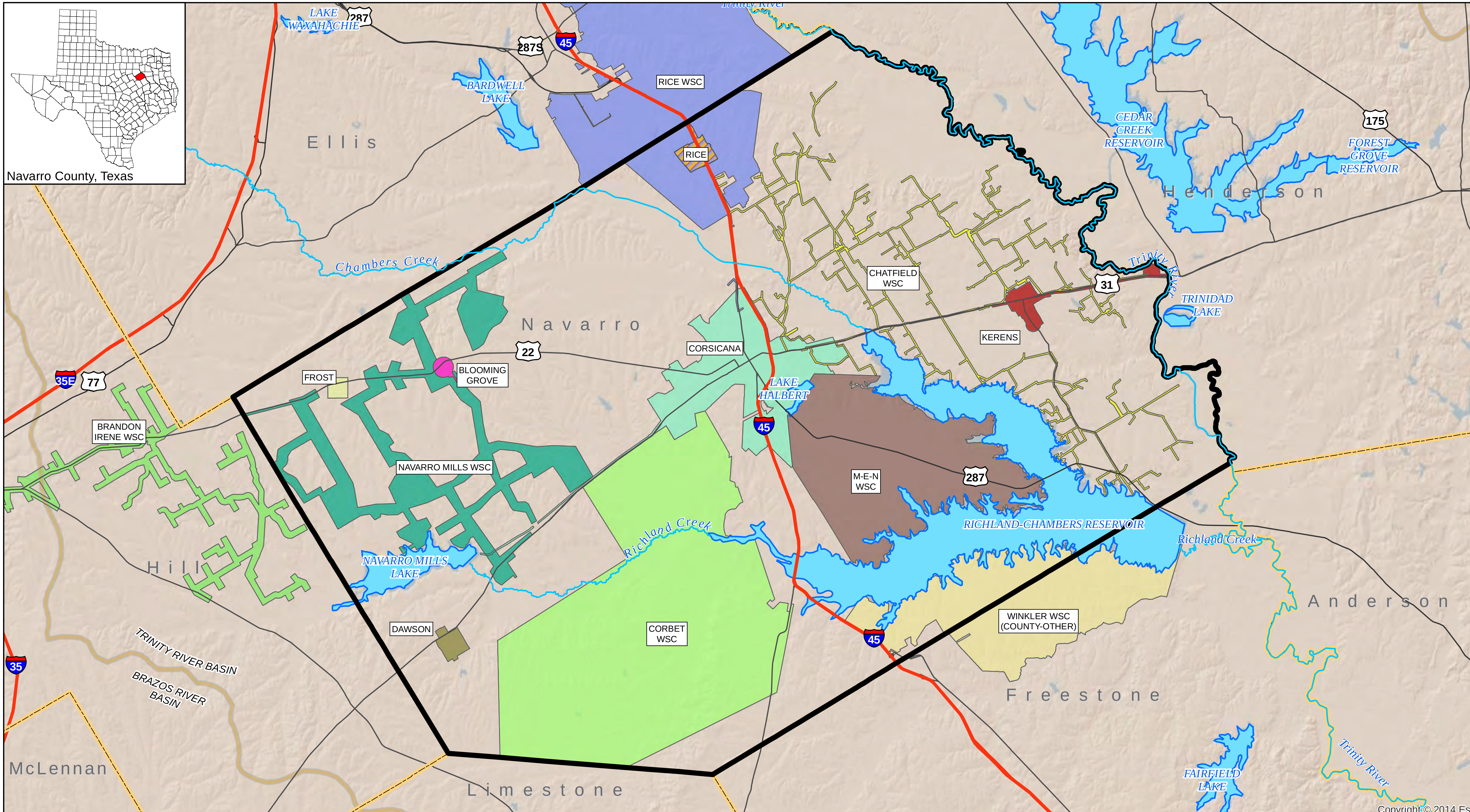
5D.12 Navarro County

Figure 5D.12 is a map of Navarro County. The City of Corsicana is a wholesale water provider and supplies treated water for most of the water user groups in Navarro County. A detailed discussion of the water management strategies for Corsicana is included in Section 5C.1 of this plan. Some water user groups currently buying water from Corsicana are considering the development of independent supplies to supplement or replace water from Corsicana.

Water management strategies for Navarro County water user groups are discussed on the following pages (in alphabetical order). Table 5D.279 shows the estimated capital costs for the Navarro County water management strategies not associated with the wholesale water providers, and Table 5D.280 is a summary of the costs by category and is followed by a Navarro County summary.

Blooming Grove

Blooming Grove is a city of about 900 people located in northwestern Navarro County. The city buys treated water from Corsicana for its current supply. Water management strategies for Blooming Grove include conservation, purchasing additional water from Corsicana, and developing groundwater from the Trinity aquifer. Table 5D.262 shows the projected population and demand, the current supplies, and the water management strategies for Blooming Grove.



FREESE AND NICHOLS

Project No: NTD11336

Service Area
County Boundary
Navarro County Boundary
River Basin Divide
River
Reservoir

1 inch = 4.5 miles

0 2.25 4.5 9

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Navarro County, Texas

Figure 5D.12

Table 5D.262
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Blooming Grove

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**909**	**1,002**	**1,098**	**1,208**	**1,323**	**1,445**
Projected Water Demand						
Municipal Demand	153	164	175	191	209	228
Total Projected Water Demand	***153***	***164***	***175***	***191***	***209***	***228***
Currently Available Water Supplies						
Corsicana	153	106	105	103	99	93
Total Current Supplies	***153***	***106***	***105***	***103***	***99***	***93***
Need (Demand - Current Supply)	***0***	***58***	***70***	***88***	***110***	***135***
Water Management Strategies						
Water Conservation	1	3	4	6	8	9
Additional Water from Corsicana	0	55	66	82	102	126
Trinity Aquifer (New Wells)	160	160	160	160	160	160
Total Water Management Strategies	***161***	***218***	***230***	***248***	***270***	***295***
Reserve (Shortage)	**161**	**160**	**160**	**160**	**160**	**160**

Brandon-Irene Water Supply Corporation

Brandon-Irene Water Supply Corporation serves about 2,400 people in Ellis, Hill and Navarro Counties. The majority of the WSC's service area is in Hill County in the Brazos G region, so the water supply plans are covered in more detail in the Brazos G Regional Water Plan. Table 5D.263 shows the projected population and demand, the current supplies, and the water management strategies for Brandon-Irene WSC in Region C. The current supply is water from Aquilla Water Supply District (which purchases raw water from the Brazos River Authority, out of Lake Aquilla, and treats it.). That supply is adequate to meet projected demands, and the only water management strategy for Brandon-Irene WSC in Region C is conservation.

Table 5D.263
Projected Population and Demand, Current Supplies, and Water Management
Strategies for Brandon-Irene Water Supply Corporation (Region C Only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Region C Population	**294**	**339**	**388**	**444**	**507**	**578**

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Municipal Demand	40	44	48	55	62	71
Total Projected Region C Demand	***40***	***44***	***48***	***55***	***62***	***71***
Currently Available Water Supplies						
Aquilla WSD (Lake Aquilla, Region G)	59	66	74	84	96	109
Total Current Supplies	***59***	***66***	***74***	***84***	***96***	***109***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	0	0	0	1	1	1
Total Water Management Strategies	***0***	***0***	***0***	***1***	***1***	***1***
Reserve (Shortage)	**19**	**22**	**26**	**30**	**35**	**39**

Chatfield Water Supply Corporation

Chatfield WSC serves about 4,200 people in eastern Navarro County. The WSC gets its water supply by purchasing treated water from Corsicana. The water management strategies for Chatfield WSC are conservation, additional water from Corsicana, and developing groundwater from the Trinity aquifer. Table 5D.264 shows the projected population and demand, the current supplies, and the water management strategies for Chatfield WSC.

Table 5D.264
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Chatfield Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**4,300**	**4,400**	**4,500**	**4,600**	**4,700**	**4,800**
Projected Water Demand						
Municipal Demand	469	464	463	466	475	485
Total Projected Water Demand	***469***	***464***	***463***	***466***	***475***	***485***
Currently Available Water Supplies						
Corsicana	469	301	278	251	224	198
Total Current Supplies	***469***	***301***	***278***	***251***	***224***	***198***
Need (Demand - Current Supply)	***0***	***163***	***185***	***215***	***251***	***287***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	4	5	5	6	8	10
Additional Water from Corsicana	0	158	180	209	243	277
New wells in Trinity Aquifer	150	150	150	150	150	150
Total Water Management Strategies	***154***	***313***	***335***	***365***	***401***	***437***
Reserve (Shortage)	**154**	**150**	**150**	**150**	**150**	**150**

Corbet Water Supply Corporation

Corbet WSC serves a population of about 2,800 and is located in southern Navarro County. The WSC buys treated water from Corsicana for its current supply. Water management strategies for Corbet WSC include conservation and purchasing additional water from Corsicana. Table 5D.265 shows the projected population and demand, the current supplies, and the water management strategies for Corbet WSC.

Table 5D.265
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Corbet Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,865**	**3,159**	**3,462**	**3,808**	**4,170**	**4,556**
Projected Water Demand						
Municipal Demand	258	272	289	312	341	372
Total Projected Water Demand	***258***	***272***	***289***	***312***	***341***	***372***
Currently Available Water Supplies						
Corsicana	258	176	173	168	161	151
Total Current Supplies	***258***	***176***	***173***	***168***	***161***	***151***
Need (Demand - Current Supply)	***0***	***96***	***116***	***144***	***180***	***221***
Water Management Strategies						
Water Conservation	2	3	3	4	6	7
Additional Water from Corsicana	0	93	113	140	174	214
Total Water Management Strategies	***2***	***96***	***116***	***144***	***180***	***221***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

Corsicana

Corsicana is a city of about 16,000 people located in central Navarro County. Corsicana is a wholesale water provider, and there is a discussion of the city's water supply plans in Section 5C.1.

Dawson

Dawson has a population of about 900 and is located in southwestern Navarro County. The city buys treated water from Corsicana for its current supply. Water management strategies for Dawson include conservation and purchasing additional water from Corsicana. Table 5D.266 shows the projected population and demand, the current supplies, and the water management strategies for Dawson.

Table 5D.266
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Dawson

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**893**	**985**	**1,080**	**1,187**	**1,300**	**1,420**
Projected Water Demand						
Municipal Demand	149	160	172	187	204	223
Total Projected Water Demand	***149***	***160***	***172***	***187***	***204***	***223***
Currently Available Water Supplies						
Corsicana	149	104	103	101	96	91
Total Current Supplies	***149***	***104***	***103***	***101***	***96***	***91***
Need (Demand - Current Supply)	***0***	***56***	***69***	***86***	***108***	***132***
Water Management Strategies						
Water Conservation	1	3	4	6	7	9
Additional Water from Corsicana	0	53	65	80	101	123
Total Water Management Strategies	***1***	***56***	***69***	***86***	***108***	***132***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Frost

Frost is located in northwestern Navarro County and has a population of about 550. The city gets its current water supply from the Woodbine aquifer and Corsicana, and these sources are sufficient to meet projected demands. Water management strategies for Frost include conservation and additional water from Corsicana. Table 5D.267 shows the projected population and demand, the current supplies, and the water management strategies for Frost.

Table 5D.267
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Frost

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**712**	**785**	**860**	**946**	**1,036**	**1,132**
Projected Water Demand						
Municipal Demand	69	72	76	82	90	98
Total Projected Demand	***69***	***72***	***76***	***82***	***90***	***98***
Currently Available Water Supplies						
Corsicana	69	47	46	44	42	40
Woodbine Aquifer	16	16	16	16	16	16
Total Current Supplies	***85***	***63***	***62***	***60***	***58***	***56***
Need (Demand - Current Supply)	***0***	***9***	***14***	***22***	***32***	***42***
Water Management Strategies						
Water Conservation	1	1	1	1	2	2
Additional Water from Corsicana	0	24	29	37	46	56
Total Water Management Strategies	***1***	***25***	***30***	***38***	***48***	***58***
Reserve (Shortage)	**17**	**16**	**16**	**16**	**16**	**16**

Kerens

Kerens is a city of about 1,700 people located in eastern Navarro County. The city gets its current water supply by purchasing treated water from Corsicana. Water management strategies for Kerens include conservation and additional water from Corsicana. Table 5D.268 shows the projected population and demand, the current supplies, and the water management strategies for Kerens.

Table 5D.268
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Kerens

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,741**	**1,919**	**2,104**	**2,314**	**2,534**	**2,768**
Projected Water Demand						
Municipal Demand	206	218	231	252	275	300

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Projected Demand	***206***	***218***	***231***	***252***	***275***	***300***
Currently Available Water Supplies						
Corsicana	206	141	139	136	130	122
Total Current Supplies	***206***	***141***	***139***	***136***	***130***	***122***
Need (Demand - Current Supply)	***0***	***77***	***92***	***116***	***145***	***178***
Water Management Strategies						
Water Conservation	2	2	2	3	5	6
Additional Water from Corsicana	0	75	90	113	140	172
Total Water Management Strategies	***2***	***77***	***92***	***116***	***145***	***178***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

MEN Water Supply Corporation

MEN WSC serves about 3,400 people in central and southern Navarro County. The WSC gets its water supply by purchasing treated water from Corsicana. The water management strategies for MEN WSC are conservation and purchasing additional water from Corsicana, which includes increasing the delivery infrastructure from Corsicana. Table 5D.269 shows the projected population and demand, the current supplies, and the water management strategies for MEN WSC.

Table 5D.269
Projected Population and Demand, Current Supplies, and Water Management Strategies for the MEN Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,346**	**3,689**	**4,044**	**4,448**	**4,870**	**5,321**
Projected Water Demand						
Municipal Demand	472	508	548	597	652	712
Total Projected Demand	***472***	***508***	***548***	***597***	***652***	***712***
Currently Available Water Supplies						
Corsicana	472	329	329	321	307	290
Total Current Supplies	***472***	***329***	***329***	***321***	***307***	***290***
Need (Demand - Current Supply)	***0***	***179***	***219***	***276***	***345***	***422***
Water Management Strategies						
Water Conservation	4	6	5	8	11	14

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from Corsicana	0	173	214	268	334	408
Increase delivery infrastructure from Corsicana (Upsize Lake Halbert connection)	*0*	*173*	*214*	*268*	*334*	*408*
Total Water Management Strategies	***4***	***179***	***219***	***276***	***345***	***422***
Reserve (Shortage)	**4**	**0**	**0**	**0**	**0**	**0**

Navarro County Irrigation

Table 5D.270 shows the projected demand, the current supplies, and the water management strategies for Navarro County Irrigation. The current supply is local surface water supplies. Current supplies are sufficient to meet the need, and the only water management strategy for Navarro County Irrigation is conservation.

Table 5D.270
Projected Demand, Current Supplies, and
Water Management Strategies for Navarro County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**58**	**58**	**58**	**58**	**58**	**58**
Currently Available Water Supplies						
Local Supplies	226	226	226	226	226	226
Total Current Supplies	***226***	***226***	***226***	***226***	***226***	***226***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Conservation	0	2	4	5	5	6
Total Water Management Strategies	***0***	***2***	***4***	***5***	***5***	***6***
Reserve (Shortage)	**168**	**170**	**172**	**173**	**173**	**174**

Navarro County Livestock

Table 5D.271 shows the projected demand, current supplies, and water management strategies for Navarro County Livestock. The current supplies are local surface water supplies and groundwater (Carrizo-Wilcox and Nacatoch aquifers). These sources are sufficient to meet projected demands, and there are no water management strategies for this water user group.

Table 5D.271
Projected Demand, Current Supplies, and
Water Management Strategies for the Navarro County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,544**	**1,544**	**1,544**	**1,544**	**1,544**	**1,544**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	9	9	9	9	9	9
Livestock Local Supply	1,603	1,603	1,603	1,603	1,603	1,603
Nacatoch Aquifer	10	10	10	10	10	10
Total Current Supplies	***1,622***	***1,622***	***1,622***	***1,622***	***1,622***	***1,622***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**78**	**78**	**78**	**78**	**78**	**78**

Navarro County Manufacturing

Table 5D.272 shows the projected demand and current supplies for Navarro County Manufacturing. Current supplies are treated water from Corsicana and water from the Winkler WSC (source is Tarrant Regional Water District (TRWD)). (Winkler WSC is not large enough to be considered by TWDB as a water user group so it is included in Navarro County Other.) The water management strategies for this water user group are additional water from Corsicana and additional water from TRWD. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple entities, facilities, and various manufacturing processes that make up this WUG.

Table 5D.272
Projected Demand, Current Supplies, and Water
Management Strategies for the Navarro County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,114**	**1,249**	**1,384**	**1,519**	**1,654**	**1,789**
Currently Available Water Supplies						
Corsicana	1,109	806	827	814	777	727

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Navarro County Other (Winkler WSC, TRWD)	5	5	4	4	3	3
Total Current Supplies	***1,114***	***811***	***831***	***818***	***780***	***730***
Need (Demand - Current Supply)	***0***	***438***	***553***	***701***	***874***	***1,059***
Water Management Strategies						
Additional water from Corsicana	0	438	552	700	872	1,057
Additional water from TRWD	0	0	1	1	2	2
Total Water Management Strategies	***0***	***438***	***553***	***701***	***874***	***1,059***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Navarro County Mining

Table 5D.273 shows the projected demand, the current supplies, and the water management strategies for Navarro County Mining. Navarro County Mining is supplied from the Carrizo-Wilcox, Trinity, and Nacatoch aquifers, and the supply is sufficient to meet projected demands. There are no water management strategy for this water user group.

Table 5D.273
Projected Demand, Current Supplies, and
Water Management Strategies for Navarro County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**883**	**1,071**	**1,282**	**1,572**	**1,806**	**2,076**
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	6	6	6	6	6	6
Trinity Aquifer	1,100	1,100	1,100	1,100	1,100	1,100
Nacatoch Aquifer	970	970	970	970	970	970
Total Current Supplies	***2,076***	***2,076***	***2,076***	***2,076***	***2,076***	***2,076***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**1,193**	**1,005**	**794**	**504**	**270**	**0**

Navarro County Other

Navarro County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Navarro County Other supply about 5,000 people and receive their water supply from the Trinity aquifer, Corsicana, and TRWD. The population of Navarro County Other is expected to grow. Water management strategies for these entities include conservation, additional water from Corsicana, and additional water from TRWD. Table 5D.274 shows the projected population and demand, the current supplies, and the water management strategies for Navarro County Other.

Table 5D.274
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Navarro County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**5,475**	**5,475**	**5,475**	**10,000**	**20,000**	**35,000**
Projected Water Demand						
Municipal Demand	623	606	593	1,061	2,110	3,685
Total Projected Water Demand	***623***	***606***	***593***	***1,061***	***2,110***	***3,685***
Currently Available Water Supplies						
Trinity Aquifer	200	200	200	200	200	200
Corsicana	374	236	214	343	597	900
Tarrant Regional Water District	54	43	34	163	411	560
Total Current Supplies	***628***	***479***	***448***	***706***	***1,208***	***1,660***
Need (Demand - Current Supply)	***0***	***127***	***145***	***355***	***902***	***2,025***
Water Management Strategies						
Water Conservation	5	7	6	14	35	74
Additional Water from Corsicana	0	124	138	286	648	1,267
Additional Water from TRWD	0	1	6	60	224	689
Total Water Management Strategies	***5***	***132***	***150***	***360***	***907***	***2,030***
Reserve (Shortage)	**10**	**5**	**5**	**5**	**5**	**5**

Navarro County Steam Electric Power

Table 5D.275 shows the projected demand, the current supplies, and the water management strategies for Navarro County Steam Electric Power. There is no current supply for this water user group. Demands are expected to increase in the future, and the water management strategy for Navarro County Steam Electric Power is buying water from TRWD and Corsicana. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.275
Projected Demand, Current Supplies, and Water Management Strategies for Navarro County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**8,000**	**13,440**	**13,440**	**13,440**	**13,440**	**13,440**
Currently Available Water Supplies						
None	0	0	0	0	0	0
Total Current Supplies	***0***	***0***	***0***	***0***	***0***	***0***
Need (Demand - Current Supply)	***8,000***	***13,440***	***13,440***	***13,440***	***13,440***	***13,440***
Water Management Strategies						
TRWD	8,000	8,000	8,000	8,000	8,000	8,000
Corsicana	0	5,440	5,440	5,440	5,440	5,440
Total Water Management Strategies	***8,000***	***13,440***	***13,440***	***13,440***	***13,440***	***13,440***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Navarro Mills Water Supply Corporation

Navarro Mills WSC provides water for about 3,000 people in northwestern Navarro County. The WSC gets its water supply from groundwater (Woodbine aquifer) and by purchasing treated water from Corsicana. The water management strategies for Navarro Mills WSC are conservation, purchasing additional water from Corsicana, and new wells in the Woodbine aquifer. Table 5D.276 shows the projected population and demand, the current supplies, and the water management strategies for Navarro Mills WSC.

Table 5D.276
Projected Population and Demand, Current Supplies, and Water Management Strategies for Navarro Mills Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,308**	**3,648**	**3,999**	**4,398**	**4,816**	**5,261**
Projected Water Demand						
Municipal Demand	352	373	398	431	470	513
Total Projected Demand	***352***	***373***	***398***	***431***	***470***	***513***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Currently Available Water Supplies						
Corsicana	352	242	239	232	222	209
Woodbine Aquifer	205	205	205	205	205	205
Total Current Supplies	***557***	***447***	***444***	***437***	***427***	***414***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***43***	***99***
Water Management Strategies						
Water Conservation	3	4	4	6	8	10
Additional Water from Corsicana	0	127	155	193	240	294
Woodbine Aquifer (new wells)				79	79	79
Total Water Management Strategies	***3***	***131***	***159***	***278***	***327***	***383***
Reserve (Shortage)	**208**	**205**	**205**	**284**	**284**	**284**

Rice

Rice has a population of about 950 and is located in northern Navarro County. The current supply for Rice is retail service from Rice WSC (which in turn gets water from Corsicana). Water management strategies for Rice include conservation and additional water from Rice WSC. Table 5D.277 shows the projected population and demand, the current supplies, and the water management strategies for Rice.

Table 5D.277
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Rice

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,022**	**1,126**	**1,235**	**1,358**	**1,487**	**1,625**
Projected Water Demand						
Municipal Demand	163	176	190	207	226	246
Total Projected Demand	***163***	***176***	***190***	***207***	***226***	***246***
Currently Available Water Supplies						
Rice Water Supply Corporation (Corsicana)	163	114	114	111	107	100
Total Current Supplies	***163***	***114***	***114***	***111***	***107***	***100***
Need (Demand - Current Supply)	***0***	***62***	***76***	***96***	***119***	***146***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	1	2	2	3	4	5
Additional Water from Rice WSC	0	60	74	93	115	141
Total Water Management Strategies	***1***	***62***	***76***	***96***	***119***	***146***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Rice Water Supply Corporation

Rice WSC provides retail service to about 8,600 people in northern Navarro County and southeastern Ellis County in and around the City of Rice. The WSC gets most of its water supply from Corsicana, with a small supply from Ennis. Water management strategies for Rice WSC include conservation, additional water from Corsicana (including an increase in delivery infrastructure), and additional water from Ennis. Table 5D.278 shows the projected population and demand, the current supplies, and the water management strategies for Rice WSC.

Table 5D.278
Projected Population and Demand, Current Supplies, and Water Management Strategies for Rice Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population						
Outside of Rice	8,499	10,611	13,055	15,914	19,266	23,134
In Rice	1,022	1,126	1,235	1,358	1,487	1,625
Total Population Served	**9,521**	**11,737**	**14,290**	**17,272**	**20,753**	**24,759**
Projected Water Demand						
Outside of Rice	800	958	1,151	1,388	1,675	2,008
In Rice	163	176	190	207	226	246
Total Projected Demand	***963***	***1,134***	***1,341***	***1,595***	***1,901***	***2,254***
Currently Available Water Supplies						
Corsicana for Rice WSC	750	588	661	720	766	797
Corsicana for Rice	163	114	114	111	107	100
Ennis	48	46	41	34	22	13
Total Current Supplies	***961***	***748***	***816***	***865***	***895***	***910***
Need (Demand - Current Supply)	***2***	***386***	***525***	***730***	***1,006***	***1,344***
Water Management Strategies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water Conservation (Outside Rice)	7	10	12	19	28	40
Water Conservation (Inside Rice)	1	2	2	3	4	5
Add'l Corsicana for Rice WSC	0	310	428	599	831	1,121
Add'l Corsicana for Rice	0	60	74	93	115	141
Increase delivery infrastructure from Corsicana	*0*	*0*	*156*	*402*	*698*	*1,038*
Additional Water from Ennis	0	0	9	16	28	37
Total Water Management Strategies	***8***	***382***	***525***	***730***	***1,006***	***1,344***
Reserve (Shortage)	**8**	**0**	**0**	**0**	**0**	**0**

Costs for Navarro County Water User Groups

Table 5D.279 shows the estimated capital costs for Navarro County water management strategies not covered under the wholesale water providers. Table 5D.280 summarizes the costs by category and is followed by a summary for Navarro County.

Table 5D.279
Costs for Recommended Water Management Strategies for Navarro County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Blooming Grove	Conservation	2020	9	$10,087	$2.59	$1.44	Q-10
	Additional Corsicana	2030	126	$0	$3.25	$3.25	None
	Groundwater	2020	160	$1,669,300	$4.14	$1.46	Q-164
Brandon-Irene WSC* (Region C only)	Conservation	2020	1	$98	$0.00	$0.00	Q-10
Chatfield WSC	Conservation	2020	10	$12,778	$0.82	$0.00	Q-10
	Additional Corsicana	2030	277	$0	$3.25	$3.25	None
	New Well	2020	150	$1,000,000	$2.87	$1.15	Q-165
Corbet WSC	Conservation	2020	7	$4,009	$0.51	$0.00	Q-10
	Additional Corsicana	2030	214	$0	$3.25	$3.25	None
Corsicana	Conservation	2020	364	$248,252	$2.36	$0.74	Q-10
	Other measures	See Corsicana in Section 5C.2.					
Dawson	Conservation	2020	9	$2,995	$0.77	$1.41	Q-10
	Additional Corsicana	2030	123	$0	$3.25	$3.25	None

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Frost	Conservation	2020	2	$4,559	$1.17	$0.00	Q-10
	Additional Corsicana	2030	56	$0	$3.25	$3.25	None
Kerens	Conservation	2020	6	$3,823	$0.49	$0.00	Q-10
	Additional Corsicana	2030	172	$0	$3.25	$3.25	None
MEN WSC	Conservation	2020	14	$9,629	$0.62	$0.00	Q-10
	Additional Corsicana	2030	408	$0	$3.25	$3.25	None
	Increase delivery infrastructure from Corsicana (Upsize Lake Halbert Connection)	*2030*	*408*	$2,521,800	$1.94	$0.35	Q-166
Navarro County Other	Conservation	2020	74	$12,260	$0.63	$0.00	Q-10
	Additional Corsicana	2030	1,267	$0	$3.25	$3.25	None
	Additional TRWD	2040	689	$0	$0.97	$0.97	None
Navarro Mills WSC	Conservation	2020	10	$10,706	$0.92	$0.00	Q-10
	New wells (Woodbine)	2050	79	$1,339,500	$3.05	$1.14	Q-168
	Additional Corsicana	2030	294	$0	$3.25	$3.25	None
Rice	Conservation	2020	5	$2,533	$0.65	$0.00	Q-10
	Additional Corsicana	2030	141	$0	$3.25	$3.25	None
Rice WSC*	Conservation	See Ellis County.					
	Additional Ennis	See Ellis County.					
	Additional Corsicana	See Ellis County.					
	Increase delivery infrastructure from Corsicana	See Ellis County.					
Navarro County Irrigation	Conservation	2030	6	$0	$0.95	$0.95	None
Navarro County Livestock	None	N/A	N/A	N/A	N/A	N/A	N/A
Navarro County Manufacturing	Additional Corsicana	2030	1,057	$0	$3.25	$3.25	None
	Additional TRWD	2020	2	$0	$0.97	$0.97	None
Navarro County Mining	None	N/A	N/A	N/A	N/A	N/A	N/A

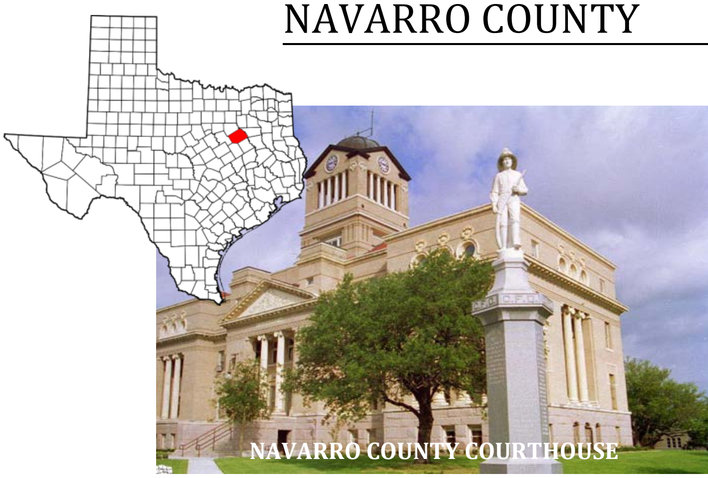
Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Navarro County Steam Electric	TRWD (Richland-Chambers)	2020	8,000	See TRWD in Section 5C.			
	Corsicana (Richland-Chambers)	2030	5,440	See Corsicana in Section 5C.			

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.280
Summary of Recommended Water Management Strategies for Navarro County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	517	$321,729
Purchase from WWP	18,266	$0
Delivery infrastructure	*408*	$2,521,800
Groundwater	389	$4,008,800
Total		**$6,852,329**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.



2010 Population: *47,735*

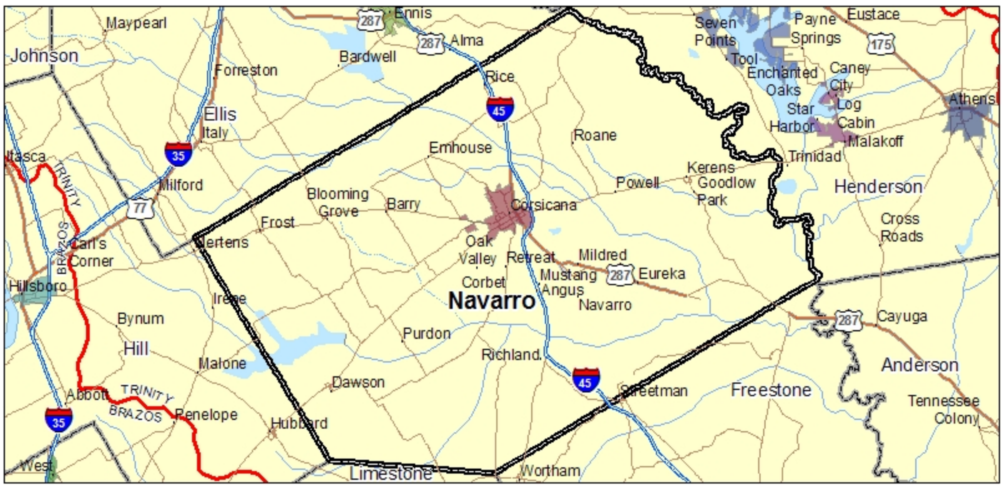
Projected 2070 Population: *107,814*

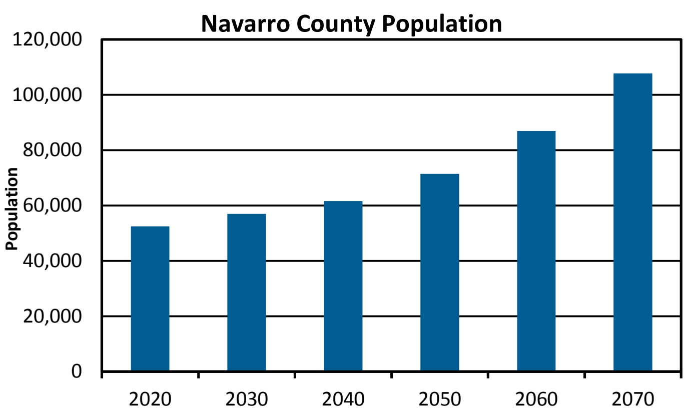
County Seat: *Corsicana*

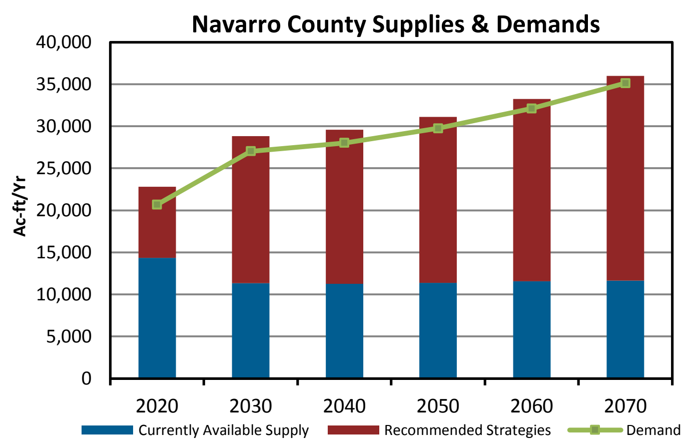
Economy: *Manufacturing; agribusinesses; oil-field operations, distribution.*

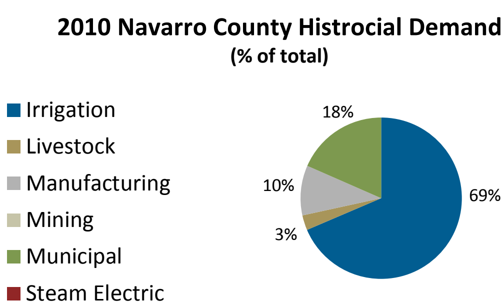
River Basin(s):

- Trinity (100%)

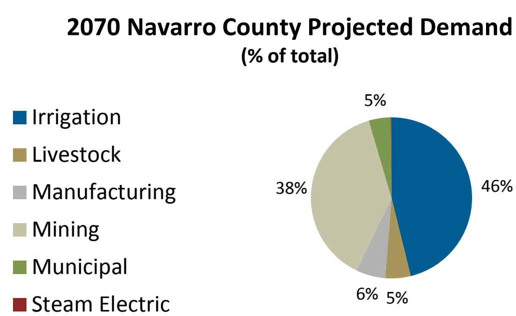








Total=11,933 acre-feet



Total= 35,114 acre-feet

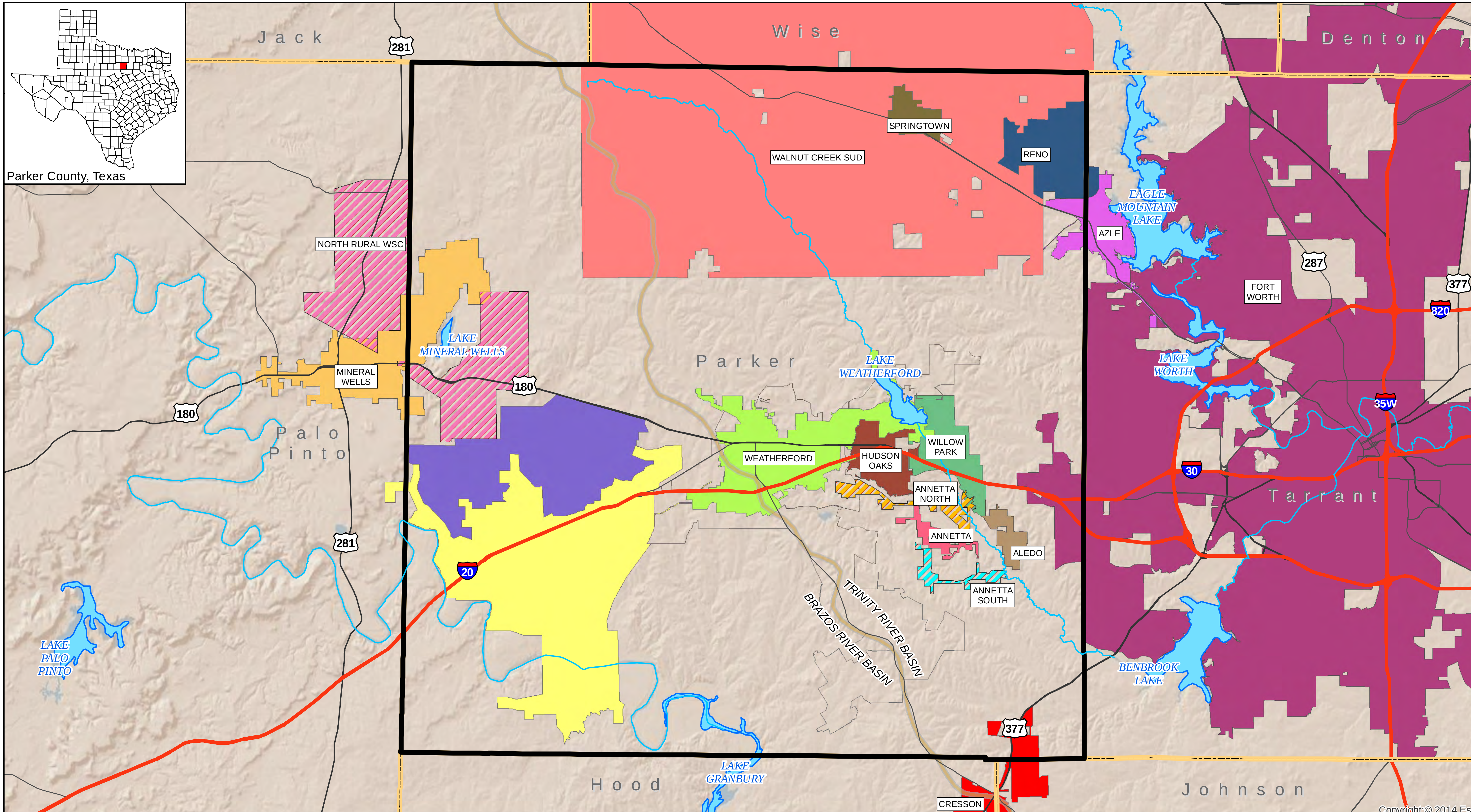
5D.13 Parker County

Figure 5D.13 is a map of Parker County. Parker County is in the Upper Trinity Groundwater Conservation District. The majority of the water user groups in Parker County meet their demands from groundwater, but the larger suppliers (Weatherford, Azle, Fort Worth, and Walnut Creek Special Utility District) rely on surface water. The demand in Parker County is expected to outgrow the available groundwater supply, and some suppliers will convert from groundwater to surface water. Weatherford and Parker County Other will build and/or expand water treatment plants in the county. Fort Worth, Azle, and Walnut Creek SUD will build and/or expand plants outside of the county and bring additional supplies into Parker County.

Water management strategies for Parker County water user groups are discussed on the following pages (in alphabetical order). Table 5D.298 shows the estimated capital costs for the Parker County recommended water management strategies not associated with the wholesale water providers, and Table 5D.299 is a summary of the costs by category. Table 5D.300 shows the estimated capital costs for the Parker County alternative strategies not associated with the wholesale water providers. Table 5D.300 is followed by a Parker County summary.

Aledo

Aledo is a city of about 3,000 people located in eastern Parker County. The city gets part of its current water supply from wells in the Trinity aquifer, and the city also purchases treated water from Fort Worth (which gets raw water from TRWD and treats it). Water management strategies for Aledo include conservation and purchasing additional treated water from Fort Worth, including adding delivery infrastructure (pipeline and pump station). Table 5D.281 shows the projected population and demand, the current supplies, and the water management strategies for Aledo.



FREESE AND NICHOLS

Project No: NTD11336

Service Area

County Boundary

Parker County Boundary

River Basin Divide

River

Reservoir

1 inch = 4 miles

0 2 4 8

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Parker County, Texas

Figure 5D.13

Table 5D.281
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Aledo

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**5,320**	**8,320**	**12,620**	**13,258**	**13,258**	**13,258**
Projected Water Demand						
Municipal Demand	822	1,262	1,900	1,992	1,991	1,990
Total Projected Water Demand	***822***	***1,262***	***1,900***	***1,992***	***1,991***	***1,990***
Currently Available Water Supplies						
Trinity Aquifer	398	398	398	398	398	398
Fort Worth (TRWD)	626	898	1,208	1,152	1,122	1,031
Total Current Supplies	***1,024***	***1,296***	***1,606***	***1,550***	***1,520***	***1,429***
Need (Demand - Current Supply)	***0***	***0***	***294***	***442***	***471***	***561***
Water Management Strategies						
Water Conservation	7	13	19	27	33	40
Add'l Water from Fort Worth (TRWD) with infrastructure as below:	25	203	540	693	836	919
Existing pipeline & pump station (3 MGD)	*25*	*203*	*474*	*530*	*560*	*651*
New parallel pipeline & pump station (0.5 MGD)			*67*	*164*	*277*	*269*
Total Water Management Strategies	***32***	***216***	***559***	***720***	***869***	***959***
Reserve (Shortage)	**234**	**250**	**265**	**278**	**398**	**398**

Annetta

Annetta has a population of about 2,600 and is located in eastern Parker County. The current water supply for residents comes from wells in the Trinity aquifer. Water management strategies for Annetta include conservation and purchasing treated water from Weatherford (with the raw water supplied to Weatherford by TRWD). Table 5D.282 shows the projected population and demand, the current supplies, and the water management strategies for Annetta.

Table 5D.282
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Annetta

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**1,678**	**2,068**	**2,458**	**2,848**	**3,238**	**3,628**
Projected Water Demand						
Municipal Demand	152	179	208	238	270	302
Total Projected Water Demand	***152***	***179***	***208***	***238***	***270***	***302***
Currently Available Water Supplies						
Trinity Aquifer	354	354	354	354	354	354
Total Current Supplies	***354***	***354***	***354***	***354***	***354***	***354***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	2	2	3	5	6
Weatherford (Tarrant Regional WD)	0	25	28	35	90	196
Total Water Management Strategies	***1***	***27***	***30***	***38***	***95***	***202***
Reserve (Shortage)	**203**	**202**	**176**	**154**	**179**	**254**

Annetta North

Annetta North is located in eastern Parker County and has a population of about 520. The current water supply for residents comes from wells in the Trinity aquifer. Water management strategies for Annetta North include conservation and purchasing treated water from Weatherford (with the raw water supplied to Weatherford by TRWD). Table 5D.283 shows the projected population and demand, the current supplies, and the water management strategies for Annetta North.

Table 5D.283
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Annetta North

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**559**	**608**	**664**	**729**	**804**	**891**
Projected Water Demand						
Municipal Demand	67	71	76	83	91	100
Total Projected Water Demand	***67***	***71***	***76***	***83***	***91***	***100***
Currently Available Water Supplies						
Trinity Aquifer	100	100	100	100	100	100

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***100***	***100***	***100***	***100***	***100***	***100***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	1	2	2
Weatherford (Tarrant Regional WD)	0	0	7	16	25	38
Total Water Management Strategies	***1***	***1***	***8***	***17***	***27***	***40***
Reserve (Shortage)	**34**	**30**	**32**	**34**	**36**	**40**

Annetta South

Annetta South is located in eastern Parker County and has a population of about 530. The current water supply for residents comes from wells in the Trinity aquifer. Water management strategies for Annetta South include conservation and purchasing treated water from Weatherford (with the raw water supplied to Weatherford by TRWD). Table 5D.284 shows the projected population and demand, the current supplies, and the water management strategies for Annetta South.

Table 5D.284
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Annetta South

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**526**	**526**	**526**	**526**	**526**	**526**
Projected Water Demand						
Municipal Demand	63	60	58	57	57	57
Total Projected Water Demand	***63***	***60***	***58***	***57***	***57***	***57***
Currently Available Water Supplies						
Trinity Aquifer	69	69	69	69	69	69
Total Current Supplies	***69***	***69***	***69***	***69***	***69***	***69***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	1	1	1
Weatherford (Tarrant Regional WD)	0	0	5	10	16	22
Total Water Management Strategies	***1***	***1***	***6***	***11***	***17***	***23***
Reserve (Shortage)	**7**	**10**	**17**	**23**	**29**	**35**

Azle

Azle is a city of about 11,000 people located in northwestern Tarrant County and northeastern Parker County. The water management strategies for Azle are discussed under Tarrant County in Section 5D.15.

Cresson

Cresson has a population of about 750 and is located in Parker County in Region C and Hood and Johnson Counties in Region G. In Region C, Cresson's residents are provided with retail service by the City of Cresson, Bluebonnet Hills WSC, and Bourland Field, all of which use groundwater from the Trinity Aquifer. Water management strategies for the Region C portion of Cresson include conservation and a new City of Cresson well in the Trinity Aquifer. Table 5D.285 shows the projected population and demand, the current supplies, and the water management strategies for the portion of Cresson located in Region C. Water management strategies in Hood and Johnson Counties are discussed in the Brazos G Regional Water Plan.

Table 5D.285
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Cresson (Region C only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Region C Population	**451**	**505**	**566**	**637**	**720**	**815**
Projected Water Demand						
Region C Municipal Demand	68	75	83	92	104	118
Total Projected Region C Demand	***68***	***75***	***83***	***92***	***104***	***118***
Currently Available Water Supplies						
Trinity Aquifer (through various suppliers)	57	43	32	22	11	3
Total Current Supplies	***57***	***43***	***32***	***22***	***11***	***3***
Need (Demand - Current Supply)	***11***	***32***	***51***	***70***	***93***	***115***
Water Management Strategies						
Region C Water Conservation	1	1	1	1	2	2
New well in Trinity Aquifer (Parker Co)	113	113	113	113	113	113
Total Water Management Strategies	***114***	***114***	***114***	***114***	***115***	***115***
Reserve (Shortage)	**103**	**82**	**63**	**44**	**22**	**0**

Fort Worth

Fort Worth is a city of about 781,000 located primarily in Tarrant County, with some population in Denton, Parker, and Wise Counties in Region C and in Johnson County in Region G. Fort Worth is a wholesale water provider, and the city's water supply plans are discussed in Section 5C.1.

Hudson Oaks

Hudson Oaks is a city of about 1,900 people located in central and eastern Parker County. The city gets its current water supply from wells in the Trinity aquifer and treated water purchased from Weatherford (supplied from TRWD raw water as well as Lake Weatherford). Water management strategies for Hudson Oaks include conservation and purchasing additional treated water from Weatherford. Table 5D.286 shows the projected population and demand, the current supplies, and the water management strategies for Hudson Oaks.

Table 5D.286
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Hudson Oaks

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**2,673**	**3,684**	**4,695**	**4,808**	**4,808**	**4,808**
Projected Water Demand						
Municipal Demand	458	618	779	795	795	795
Total Projected Demand	***458***	***618***	***779***	***795***	***795***	***795***
Currently Available Water Supplies						
Trinity Aquifer	229	309	390	398	398	398
Weatherford (TRWD)	229	281	313	245	146	132
Weatherford (Lake Weatherford)	106	120	128	84	55	38
Total Current Supplies	***564***	***710***	***831***	***727***	***599***	***568***
Need (Demand - Current Supply)	***0***	***0***	***0***	***69***	***197***	***228***
Water Management Strategies						
Water Conservation	9	19	27	30	33	36
Additional Weatherford (TRWD)	0	0	0	39	164	192
Total Water Management Strategies	***9***	***19***	***27***	***69***	***197***	***228***
Reserve (Shortage)	**115**	**111**	**79**	**0**	**0**	**0**

Mineral Wells

Mineral Wells has a population of about 16,800 and is located in eastern Palo Pinto County (in the Brazos G Region) and western Parker County. The city gets its water supply from Palo Pinto County Water Control and Improvement District Number 1 (which diverts and treats water from Lake Palo Pinto in the Brazos G region). Conservation is the only water management strategy for Mineral Wells in Region C. Table 5D.287 shows the projected population and demand, the current supplies, and the water management strategies for Mineral Wells in Region C. Brazos G region strategies for Mineral Wells are discussed in the Brazos G Regional Water Plan.

Table 5D.287
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Mineral Wells (Region C only)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population in Region C	**2,119**	**2,089**	**2,055**	**2,015**	**1,969**	**1,915**
Projected Water Demand in Region C						
Municipal Demand	346	332	320	310	302	294
Total Projected Demand in Region C	***346***	***332***	***320***	***310***	***302***	***294***
Currently Available Water Supplies						
Palo Pinto County WCID # 1	346	332	320	310	302	294
Total Current Supplies	***346***	***332***	***320***	***310***	***302***	***294***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	6	9	3	4	5	6
Total Water Management Strategies	***6***	***9***	***3***	***4***	***5***	***6***
Reserve (Shortage)	**6**	**9**	**3**	**4**	**5**	**6**

Parker County Irrigation

Table 5D.288 shows the projected demand, the current supplies, and the water management strategies for Parker County Irrigation. The current supplies are local surface water supplies, direct reuse, groundwater (Trinity aquifer), and Weatherford. These sources are sufficient to meet projected demands, and there are no water management strategies.

Table 5D.288
Projected Demand, Current Supplies,
and Water Management Strategies for Parker County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**490**	**490**	**490**	**490**	**490**	**490**
Currently Available Water Supplies						
Local Supplies	239	239	239	239	239	239
Direct Reuse	97	97	97	97	97	97
Trinity Aquifer	246	246	246	246	246	246
Weatherford	13	13	13	13	13	13
Total Current Supplies	***595***	***595***	***595***	***595***	***595***	***595***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**105**	**105**	**105**	**105**	**105**	**105**

Parker County Livestock

Table 5D.289 shows the projected demand, current supplies, and water management strategies for Parker County Livestock. The current supplies are local surface water supplies and groundwater from the Trinity aquifer. These sources are sufficient to meet projected demands, and there are no water management strategies.

Table 5D.289
Projected Demand, Current Supplies
and Water Management Strategies for Parker County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,544**	**1,544**	**1,544**	**1,544**	**1,544**	**1,544**
Currently Available Water Supplies						
Trinity Aquifer	229	229	229	229	229	229
Local Supplies	1,922	1,922	1,922	1,922	1,922	1,922
Total Current Supplies	***2,151***	***2,151***	***2,151***	***2,151***	***2,151***	***2,151***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**607**	**607**	**607**	**607**	**607**	**607**

Parker County Manufacturing

Table 5D.290 shows the projected demand and current supplies for Parker County Manufacturing. Current supplies are groundwater (Trinity aquifer), treated water from Mineral Wells (Palo Pinto County WCID #1 and Lake Palo Pinto), treated water from Weatherford (part from Lake Weatherford and part from TRWD), and treated water from Walnut Creek SUD (from TRWD sources). The water management strategies for this water user group are conservation, additional water from Weatherford, and additional water from Walnut Creek SUD.

Table 5D.290
Projected Demand, Current Supplies,
and Water Management Strategies for Parker County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**638**	**729**	**821**	**912**	**1,004**	**1,095**
Currently Available Water Supplies						
Trinity Aquifer	84	84	84	84	84	84
Mineral Wells (Palo Pinto Co. WCID)	25	25	25	25	25	25
Weatherford (Lake Weatherford)	244	241	234	169	123	93
Weatherford (TRWD)	529	564	573	495	328	327
Walnut Creek SUD (TRWD)	96	99	99	97	85	71
Total Current Supplies	***978***	***1,013***	***1,015***	***870***	***645***	***600***
Need (Demand - Current Supply)	***0***	***0***	***0***	***42***	***359***	***495***
Water Management Strategies						
Water Conservation	0	1	17	25	28	31
Additional Weatherford (TRWD)	0	55	125	288	545	634
Add'l Walnut Creek SUD (TRWD)	0	10	21	35	60	87
Total Water Management Strategies	***0***	***66***	***163***	***348***	***633***	***752***
Reserve (Shortage)	**340**	**350**	**357**	**306**	**274**	**257**

Parker County Mining

Table 5D.291 shows the projected demand, the current supplies, and the water management strategies for Parker County Mining. Parker County Mining is supplied from local supplies, the Brazos River Authority, and the Trinity aquifer. The supply is sufficient to meet projected demands, and there are no water management strategies for this water user group.

Table 5D.291
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Parker County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**3,182**	**4,029**	**4,006**	**4,073**	**4,124**	**4,364**
Currently Available Water Supplies						
Local supplies	20	20	20	20	20	20
Brazos River Authority	44	35	26	18	9	0
Trinity Aquifer	4,344	4,344	4,344	4,344	4,344	4,344
Total Current Supplies	***4,408***	***4,399***	***4,390***	***4,382***	***4,373***	***4,364***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**1,226**	**370**	**384**	**309**	**249**	**0**

Parker County Other

Parker County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Parker County Other supply about 50,000 people, and the population is expected to grow. Sources of supply for Parker County Other include Mineral Wells (from Palo Pinto County WCID #1 and Lake Palo Pinto), local supplies, groundwater (Trinity and Other aquifers), and Walnut Creek SUD (TRWD sources). Water management strategies for Parker County Other include conservation, water from Weatherford, additional water from Walnut Creek SUD, new wells in the Trinity Aquifer, and connecting to TRWD including a new water treatment plant. Table 5D.292 shows the projected population and demand, the current supplies, and the water management strategies for Parker County Other.

Table 5D.292
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Parker County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**54,108**	**54,108**	**54,108**	**75,898**	**116,910**	**181,910**
Projected Water Demand						
Municipal Demand	7,027	6,851	6,714	9,269	14,205	22,058
Total Projected Water Demand	***7,027***	***6,851***	***6,714***	***9,269***	***14,205***	***22,058***
Currently Available Water Supplies						
Trinity Aquifer	6,575	6,575	6,575	6,575	6,575	6,575
Other Aquifer	50	50	50	50	50	50
Local Supplies	33	33	33	33	33	33
Mineral Wells (Palo Pinto Co. WCID)	957	957	957	957	957	957
Walnut Creek (TRWD)	211	187	162	198	240	285
Total Current Supplies	***7,826***	***7,802***	***7,777***	***7,813***	***7,855***	***7,900***
Need (Demand - Current Supply)	***0***	***0***	***0***	***1,456***	***6,350***	***14,158***
Water Management Strategies						
Water Conservation	59	81	67	124	237	441
New wells in Trinity Aquifer	200	200	200	200	200	200
Water from Weatherford	0	0	0	1,403	2,488	3,978
Water from TRWD with water treatment plant	0	0	0	0	3,635	9,618
Add'l Water from Walnut Creek SUD	0	17	37	76	179	364
Total Water Management Strategies	***259***	***298***	***304***	***1,803***	***6,739***	***14,601***
Reserve (Shortage)	**1,058**	**1,249**	**1,367**	**347**	**389**	**443**

Parker County Special Utility District

Parker County SUD is a new WUG in this round of planning. In previous Region C Plans it was included as part of Parker County Other. Parker County SUD supplies around 6,000 people in rural western Parker County, and receives its water supply from Mineral Wells (from Palo Pinto County WCID #1 and Lake Palo Pinto), the Brazos River Authority (in Region G), and groundwater (Trinity aquifer). Water management strategies for Parker County SUD include conservation, 1 MGD expansion of the water treatment plant to treat water from the Brazos River purchased from the Brazos River Authority, and additional groundwater through new wells in the Trinity aquifer. Table 5D.293 shows the projected population and demand, the current supplies, and the water management strategies for Parker County SUD.

Table 5D.293
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Parker County Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,162**	**8,161**	**10,420**	**13,069**	**16,140**	**19,687**
Projected Water Demand						
Municipal Demand	655	842	1,060	1,321	1,627	1,983
Total Projected Water Demand	***655***	***842***	***1,060***	***1,321***	***1,627***	***1,983***
Currently Available Water Supplies						
Mineral Wells (Palo Pinto Co. WCID)	294	294	294	294	294	294
Brazos River Authority	561	561	561	561	561	561
Trinity Aquifer	36	36	36	36	36	36
Total Current Supplies	***891***	***891***	***891***	***891***	***891***	***891***
Need (Demand - Current Supply)	***0***	***0***	***170***	***431***	***737***	***1,093***
Water Management Strategies						
Water Conservation	5	9	11	18	27	40
1 MGD water treatment plant expansion and Water from BRA (Region G)	540	540	540	540	540	540
Additional Groundwater (new wells)					513	513
Total Water Management Strategies	***545***	***549***	***551***	***558***	***1,080***	***1,093***
Reserve (Shortage)	**780**	**597**	**381**	**127**	**343**	**0**

Parker County Steam Electric Power

Table 5D.294 shows the projected demand, the current supplies, and the water management strategies for Parker County Steam Electric Power. Parker County Steam Electric Power is supplied by Weatherford (from Lake Weatherford), and the water management strategy is additional water from Weatherford. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.294
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Parker County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**260**	**260**	**260**	**260**	**260**	**260**
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Weatherford (Lake Weatherford)	380	338	294	240	201	172
Total Current Supplies	***380***	***338***	***294***	***240***	***201***	***172***
Need (Demand - Current Supply)	***0***	***0***	***0***	***20***	***59***	***88***
Water Management Strategies						
Additional Weatherford (TRWD)	0	0	0	20	59	88
Total Water Management Strategies	***0***	***0***	***0***	***20***	***59***	***88***
Reserve (Shortage)	**120**	**78**	**34**	**0**	**0**	**0**

Reno

Reno is a city of about 2,500 people located in northeastern Parker County and northwest Tarrant County. The city gets its current water supply from wells in the Trinity aquifer and treated water purchased from Walnut Creek SUD (from TRWD raw water). Water management strategies for Reno include conservation and purchasing additional treated water from Walnut Creek SUD. Table 5D.295 shows the projected population and demand, the current supplies, and the water management strategies for Reno.

Table 5D.295
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Reno

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,535**	**2,585**	**2,640**	**2,703**	**2,775**	**2,856**
Projected Water Demand						
Municipal Demand	172	175	178	183	187	193
Total Projected Demand	***172***	***175***	***178***	***183***	***187***	***193***
Currently Available Water Supplies						
Trinity Aquifer	167	167	167	167	167	167
Walnut Creek SUD (TRWD)	50	46	40	36	28	22
Total Current Supplies	***217***	***213***	***207***	***203***	***195***	***189***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***4***
Water Management Strategies						
Water Conservation	1	2	2	2	3	4
Add’l Walnut Creek SUD (TRWD)	0	2	8	12	19	24
Total Water Management Strategies	***1***	***4***	***10***	***14***	***22***	***28***
Reserve (Shortage)	**46**	**42**	**39**	**34**	**30**	**24**

Springtown

Springtown is a city of about 2,700 people located in northern Parker County. The city gets its current water supply from wells in the Trinity aquifer and its own water treatment plant (using raw water purchased from TRWD). Water management strategies for Springtown include conservation, additional water from the Trinity aquifer (new wells), and additional raw water from TRWD with improvements to the lake intake structure due to potentially lower lake levels. Table 5D.296 shows the projected population and demand, the current supplies, and the water management strategies for Springtown.

Table 5D.296
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Springtown

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (In City Only)	**4,079**	**5,500**	**5,500**	**5,500**	**5,500**	**5,500**
Projected Water Demand						
Municipal Demand	577	757	749	745	744	743
Total Projected Demand	***577***	***757***	***749***	***745***	***744***	***743***
Currently Available Water Supplies						
Trinity Aquifer	95	95	95	95	95	95
Tarrant Regional Water District	340	340	340	340	340	327
Total Current Supplies	***435***	***435***	***435***	***435***	***435***	***422***
Need (Demand - Current Supply)	***142***	***322***	***314***	***310***	***309***	***321***
Water Management Strategies						
Water Conservation	5	8	7	10	12	15
Trinity Aquifer - new wells	70	70	70	70	70	70
Additional Water from TRWD	67	244	237	230	227	236
Infrastructure needs (Lake Intake modifications for lower lake levels)	*67*	*244*	*237*	*230*	*227*	*236*
Total Water Management Strategies	***142***	***322***	***314***	***310***	***309***	***321***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Walnut Creek Special Utility District

Walnut Creek SUD provides retail and wholesale supplies in northern Parker County and southern Wise County. The SUD is a wholesale water provider, and its water supply plans are discussed in Section 5C.2.

Weatherford

Weatherford is a city of about 26,000 located in central Parker County. Weatherford is a wholesale water provider, and its water supply plans are discussed in Section 5C.2.

Willow Park

Willow Park is located in eastern Parker County and has a population of about 4,500. Willow Park gets its water supply from groundwater (Trinity aquifer). Water management strategies for Willow Park include conservation and purchasing treated water from Weatherford (with the raw water supplied to Weatherford by TRWD). An alternative water management strategies for Willow Park would be purchasing treated water from Fort Worth (raw water from TRWD). Table 5D.297 shows the projected population and demand, the current supplies, and the water management strategies for Willow Park.

Table 5D.297
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Willow Park

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**4,877**	**5,960**	**7,184**	**10,000**	**13,000**	**16,000**
Projected Water Demand						
Municipal Demand	759	904	1,074	1,483	1,924	2,366
Total Projected Demand	***759***	***904***	***1,074***	***1,483***	***1,924***	***2,366***
Currently Available Water Supplies						
Trinity Aquifer	757	757	757	757	757	757
Total Current Supplies	***757***	***757***	***757***	***757***	***757***	***757***
Need (Demand - Current Supply)	***2***	***147***	***317***	***726***	***1,167***	***1,609***
Water Management Strategies						
Water Conservation	6	10	11	20	32	47
Weatherford (TRWD)	0	137	306	706	1,135	1,562
Total Water Management Strategies	***6***	***147***	***317***	***726***	***1,167***	***1,609***
Reserve (Shortage)	**4**	**0**	**0**	**0**	**0**	**0**
Alternative Water Management Strategies						
Fort Worth (TRWD)	0	137	306	706	1,135	1,562

Costs for Parker County Water User Groups

Table 5D.298 shows the estimated capital costs for Parker County recommended water management strategies not covered under the wholesale water providers. Table 5D.299 summarizes the costs by category. Table 5D.300 shows the estimated capital costs for Parker County alternative water management strategies not covered under the wholesale water providers. Table 5D.300 is followed by a summary for Parker County.

Table 5D.298
Costs for Recommended Water Management Strategies for Parker County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Aledo	Conservation	2020	40	$21,877	$0.80	$0.00	Q-10
	Fort Worth (TRWD)	2020	919	$0	$1.96	$1.96	None
	Parallel pipeline and pump station from Fort Worth	*2040*	*277*	$7,710,500	$8.18	$1.03	Q-169
Annetta	Conservation	2020	6	$2,716	$0.70	$0.00	Q-10
	Connect to Weatherford (TRWD)	2030	196	$2,077,600	$6.80	$4.07	Q-171
Annetta North	Conservation	2020	2	$1,136	$0.29	$0.00	Q-10
	Connect to Weatherford (TRWD)	2040	38	$59,400	$4.28	$3.88	Q-171
Annetta South	Conservation	2020	1	$1,026	$0.26	$0.00	Q-10
	Connect to Weatherford (TRWD)	2040	22	$1,183,300	$18.83	$5.02	Q-171
Azle*	Conservation	See Tarrant County.					
	Additional TRWD	See Tarrant County.					
	Water treatment plant expansion	See Tarrant County.					
Cresson*	Conservation	2020	2	$5,210	$1.34	$0.00	Q-10
	New wells in Trinity Aquifer	2020	113	$917,300	$2.89	$0.79	Q-170
Fort Worth*	Conservation	See Tarrant County.					
	Other Measures	See Fort Worth in Section 5C.					

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Hudson Oaks	Conservation	2020	36	$18,908	$3.45	$1.29	Q-10
	Additional Weatherford	2050	192	$0	$3.78	$3.78	None
Mineral Wells*	Conservation	2020	6	$13,723	$3.37	$0.00	Q-10
Parker County Other	Conservation	2020	441	$179,036	$0.78	$0.00	Q-10
	Additional Weatherford	2050	3,978	$0	$3.78	$3.78	None
	Additional Walnut Creek SUD	2030	364	$0	$5.25	$5.25	None
	Supply from TRWD	2060	9,618	$0	$0.97	$0.97	None
	Water Treatment Plant and Transmission Facilities	*2060*	*9,618*	$116,775,000	$5.12	$2.01	Q-174
	New wells in Trinity Aquifer	2020	200	$1,448,000	$2.61	$0.75	Q-173
Parker County SUD*	Conservation	2020	40	$35,633	$1.83	$0.00	Q-10
	Additional BRA with 1 MGD Treatment Plant Expansion	2020	540	$6,776,000	$4.60	$1.38	Q-13
	Additional Groundwater (new wells in Trinity aquifer)	2020	513	$3,860,000	$2.70	$0.77	Q-172
Reno	Conservation	2020	4	$1,404	$0.36	$0.00	Q-10
	Additional Walnut Creek SUD	2040	24	$0	$5.25	$5.25	None
Springtown	Conservation	2020	15	$6,872	$0.35	$0.00	Q-10
	Additional TRWD	2020	244	$0	$0.97	$0.97	None
	Infrastructure improvements at Lake intake	*2020*	*244*	$280,200	$0.37	$0.08	Q-175
	New wells in Trinity Aquifer	2020	70	$998,400	$4.81	$1.12	Q-176
Walnut Creek SUD*	Conservation	2020	117	$75,798	$1.30	$0.00	Q-10
	Other Measures	See Walnut Creek SUD in Section 5C.2.					
Weatherford	Conservation	2020	1,756	$3,295,000	$10.25	$1.29	Q-10
	Other Measures	See Weatherford in Section 5C.2.					

Water User Group	Strategy	Imple-mented by:	Quantity ** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Willow Park	Conservation	2020	47	$40,117	$1.72	$0.00	Q-10
	Supply from Weatherford	2030	1,562	$0	$3.78	$3.78	None
	Connect to Weatherford (TRWD) – Phase I	*2030*	*306*	$588,100	$4.43	$3.94	Q-171
Parker County Irrigation	None	N/A	N/A	N/A	N/A	N/A	N/A
Parker County Livestock	None	N/A	N/A	N/A	N/A	N/A	N/A
Parker County Manufacturing	Conservation	2030	31	$0	$0.95	$0.95	Q-11
	Additional Weatherford	2030	634	$0	$3.78	$3.78	None
	Additional Walnut Creek SUD	2030	87	$0	$5.25	$5.25	None
Parker County Mining	None	N/A	N/A	N/A	N/A	N/A	N/A
Parker County Steam Electric	Additional Weatherford	2050	88	$0	$1.89	$1.89	None

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.299
Summary of Recommended Water Management Strategies for Parker County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	2,544	$3,698,456
Purchase from WWP	17,965	$3,320,300
Delivery infrastructure	*827*	$8,578,800
Treatment plants	*10,158*	$123,551,000
Groundwater	896	$7,223,700
Total		**$146,372,256**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

Table 5D.300
Summary of Alternative Water Management Strategies for Parker County Not Covered Under Wholesale Water Providers

Type of Strategy	Entity	Quantity (Ac-Ft/Yr)	Capital Costs
Connect to Fort Worth (TRWD)	Willow Park	1,562	$4,430,000
Total			**$4,430,000**

2010 Population: *116,927*

Projected 2070 Population: *629,277*

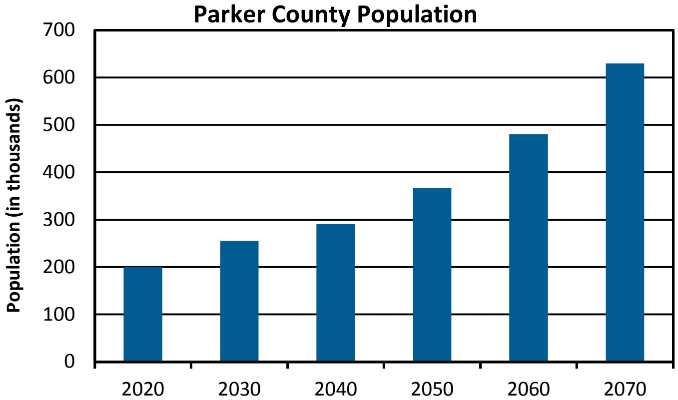
County Seat: *Weatherford*

Economy: *Agribusiness; manufacturing; government/services.*

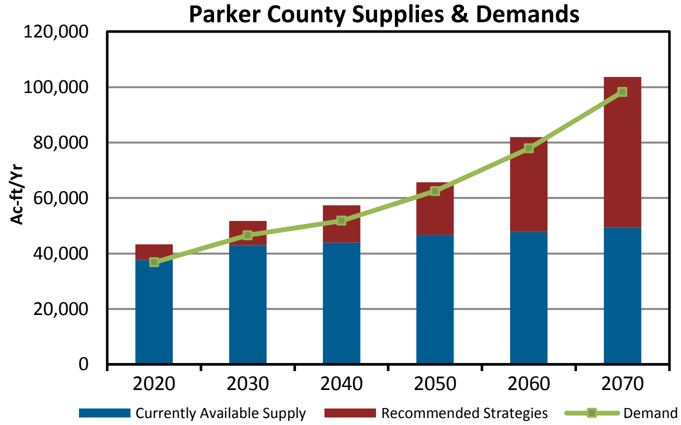
River Basin(s):

- Trinity (53%), Brazos (47%)

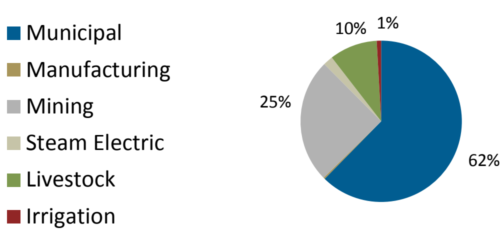
Parker County Population



Parker County Supplies & Demands

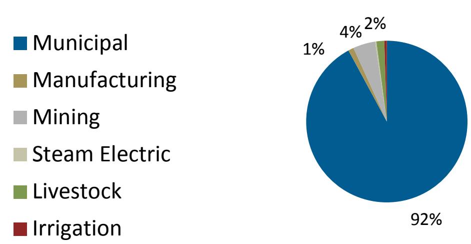


2010 Parker County Historical Demand
(% of total)



Total=23,562 acre-feet

2070 Parker County Projected Demand
(% of total)



Total= 98,251 acre-feet

5D.14 Rockwall County

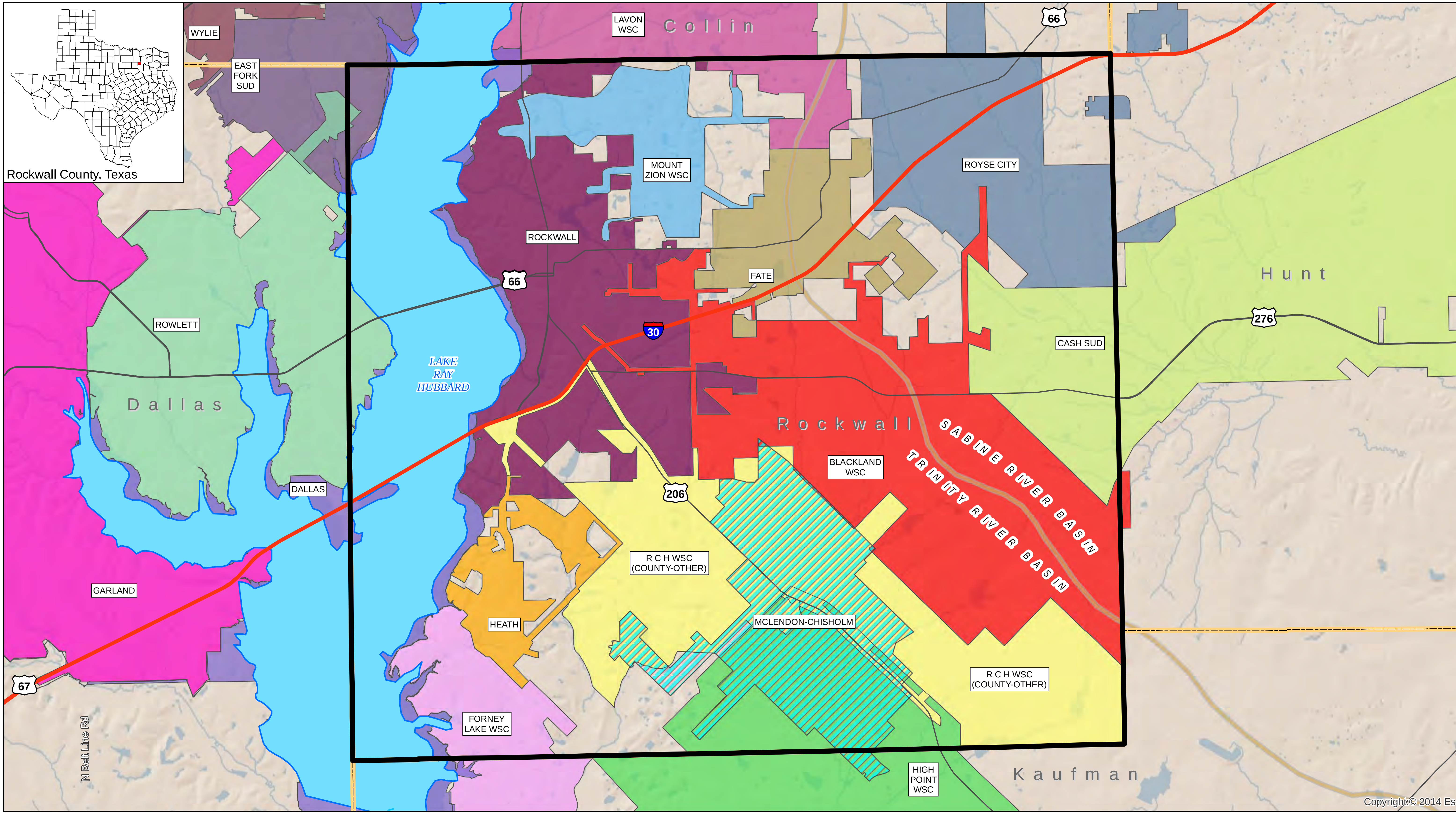
Figure 5D.14 is a map of Rockwall County. Rockwall County has limited groundwater supplies. The North Texas Municipal Water District (NTMWD) supplies most of the water used in Rockwall County and will continue to do so in the future. Water user groups that currently get water from NTMWD will purchase additional water from NTMWD to meet future demands. Water user groups that will obtain additional water from sources other than NTMWD include the following:

- The small portion of Dallas located in Rockwall County will continue to be supplied by Dallas Water Utilities.
- Cash SUD is partially supplied by the Sabine River Authority (Region D), as well as by the NTMWD.

Water management strategies for Rockwall County water user groups are discussed on the following pages (in alphabetical order). Table 5D.313 shows the estimated capital costs for the Rockwall County water management strategies not associated with the wholesale water providers, and Table 5D.314 is a summary of the costs by category. Table 5D.314 is followed by a Rockwall County summary.

Blackland Water Supply Corporation

Blackland WSC is located in eastern Rockwall County, with a small area in Hunt County, and serves about 3,300 people. The WSC gets its water supply from the North Texas Municipal Water District (NTMWD) through Rockwall. Water management strategies for Blackland WSC include conservation, establishing a direct connection with NTMWD, and additional water from NTMWD. Table 5D.301 shows the projected population and demand, the current supplies, and the water management strategies for Blackland WSC.



FREESE AND NICHOLS

Project No: NTD11336

Service Area

County Boundary

Rockwall County Boundary

River Basin Divide

River

Reservoir

N W E S

1 inch = 1.5 miles

0 0.75 1.5 3

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Rockwall County, Texas

Figure 5D.14

Table 5D.301
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Blackland WSC (Regions C & D)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,350**	**3,584**	**3,850**	**4,119**	**4,419**	**4,737**
Projected Water Demand						
Municipal Demand	678	712	754	800	857	918
Total Projected Water Demand	***678***	***712***	***754***	***800***	***857***	***918***
Currently Available Water Supplies						
NTWMD (through Rockwall)	618	540	528	528	530	526
Total Current Supplies	***618***	***540***	***528***	***528***	***530***	***526***
Need (Demand - Current Supply)	***60***	***172***	***226***	***272***	***327***	***392***
Water Management Strategies						
Water Conservation	12	19	22	26	31	36
Direct Connection and Additional Water from NTMWD	48	153	204	246	296	356
Total Water Management Strategies	***60***	***172***	***226***	***272***	***327***	***392***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Cash Special Utility District

Cash SUD provides water supply in eastern Rockwall County in Region C and in Hopkins, Hunt and Rains Counties in the North East Texas Region (Region D). Most of the SUD's customers are in the North East Texas Region. Cash SUD's current water supplies are from NTWMD in Region C and from SRA in the North East Texas Region. Table 5D.302 shows the projected population and demand in both Region C and Region D, shows the current supplies, and shows the water management strategies for the Region C portion of Cash SUD.

Cash SUD has a contract with NTMWD for 2.2 MGD (2,466 acre-feet/year). Additional supply comes from the Sabine River Authority in Region D (either as currently available supply or as part of a future strategy; see the North East Texas Regional Plan for details on supply and strategies from SRA). Cash SUD operates its own water treatment plant in the North East Texas Region to treat the supply from SRA.

The supply from NTWMD is sufficient meet all of Cash SUD's Region C demands with enough excess to send some supply to the North East Texas Region's portion of Cash SUD. Water management strategies in Region C include conservation and additional water from NTMWD, with an increase in delivery infrastructure from NTMWD.

Table 5D.302
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Cash Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (C&D)	**19,973**	**23,972**	**28,708**	**34,308**	**40,986**	**48,933**
Projected Population (D)	18,784	22,432	26,769	31,966	38,194	45,664
Projected Population (C)	1,189	1,540	1,939	2,342	2,792	3,269
Projected Water Demand (C&D)						
Municipal Demand (D)	2,159	2,497	2,924	3,460	4,123	4,923
Municipal Demand (C)	137	172	212	254	302	353
Total Projected Region C Demand	***2,296***	***2,669***	***3,136***	***3,714***	***4,425***	***5,276***
Currently Available Water Supplies						
North Texas Municipal Water District	1,301	1,391	1,684	1,642	1,539	1,424
Sabine River Authority (either current supply or part of a strategy)	1,651	4,705	4,705	4,705	4,704	4,679
Total Current Supplies	***2,952***	***6,096***	***6,389***	***6,347***	***6,243***	***6,103***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	2	2	3	5	7
Additional NTWMD	1,165	1,075	782	824	927	1,042
Increase delivery infrastructure from NTWMD	*1,165*	*1,075*	*782*	*824*	*927*	*1,042*
Total Water Management Strategies	***1,166***	***1,077***	***784***	***827***	***932***	***1,049***
Reserve (Shortage)	**1,822**	**4,504**	**4,037**	**3,460**	**2,750**	**1,876**
Region C Supply available to Region D	**2,329**	**2,294**	**2,254**	**2,212**	**2,164**	**2,113**

Dallas

Dallas Water Utilities (DWU) is the water utility of the City of Dallas, which has a population of about 1,230,000. DWU is a wholesale water provider. The City of Dallas is primarily in Dallas County but extends into Collin, Denton, and Rockwall Counties. There is a detailed discussion of water supply plans for DWU beginning in Section 5C.1.

East Fork Special Utility District

East Fork SUD is located in southern Collin County and extends into Dallas and Rockwall Counties. The water management strategies for East Fork SUD are described under Collin County in Section 5D.1.

Fate

Fate is a city of about 9,800 people located in northern Rockwall County. The city gets its water supply from the North Texas Municipal Water District (NTMWD), and water management strategies include conservation and additional water from NTMWD with an increase in delivery infrastructure. Table 5D.303 shows the projected population and demand, the current supplies, and the water management strategies for Fate.

Table 5D.303
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Fate

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**9,825**	**14,083**	**18,924**	**23,821**	**29,290**	**45,000**
Projected Water Demand						
Municipal Demand	1,731	2,457	3,291	4,135	5,079	7,797
Total Projected Demand	***1,731***	***2,457***	***3,291***	***4,135***	***5,079***	***7,797***
Currently Available Water Supplies						
NTWMD	1,595	1,883	2,324	2,753	3,169	4,503
Total Current Supplies	***1,595***	***1,883***	***2,324***	***2,753***	***3,169***	***4,503***
Need (Demand - Current Supply)	***136***	***574***	***967***	***1,382***	***1,910***	***3,294***
Water Management Strategies						
Water Conservation	32	62	99	138	186	312
Additional Water from NTMWD	104	512	868	1,244	1,724	2,982
Increase delivery infrastructure from NTMWD	*0*	*0*	*0*	*0*	*390*	*2,982*
Total Water Management Strategies	***136***	***574***	***967***	***1,382***	***1,910***	***3,294***

Forney Lake Water Supply Corporation

Forney Lake WSC supplies water to about 6,300 people in northwestern Kaufman County and southwestern Rockwall County. Water management strategies for Forney Lake WSC are discussed on under Kaufman County in Section 5D.11.

Heath

Heath has a population of about 7,000 and is located in southwestern Rockwall County. The city gets its water supply from North Texas Municipal Water District (NTMWD) through the city of Rockwall. The water management strategies for Heath are conservation and additional water from NTMWD through

Rockwall. Table 5D.304 shows the projected population and demand, the current supplies, and the water management strategies for Heath.

Table 5D.304
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Heath

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**12,107**	**24,300**	**24,300**	**24,300**	**24,300**	**24,300**
Projected Water Demand						
Municipal Demand	3,945	7,839	7,826	7,818	7,816	7,815
Total Projected Demand	***3,945***	***7,839***	***7,826***	***7,818***	***7,816***	***7,815***
Currently Available Water Supplies						
NTWMD (through Rockwall)	3,635	6,007	5,527	5,205	4,876	4,513
Total Current Supplies	***3,635***	***6,007***	***5,527***	***5,205***	***4,876***	***4,513***
Need (Demand - Current Supply)	***310***	***1,832***	***2,299***	***2,613***	***2,940***	***3,302***
Water Management Strategies						
Water Conservation	78	217	262	288	314	340
Add'l Water from NTMWD (through Rockwall)	232	1,615	2,037	2,325	2,626	2,962
Total Water Management Strategies	***310***	***1,832***	***2,299***	***2,613***	***2,940***	***3,302***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

High Point Water Supply Corporation

High Point WSC supplies water to about 3,400 people in northwestern Kaufman County and southern Rockwall County. Water management strategies for High Point WSC are discussed under Kaufman County in Section 5D.11.

Lavon Water Supply Corporation

Lavon WSC has a population of about 5,200, split almost evenly between Collin and Rockwall Counties. Water management strategies for Lavon WSC are discussed under Collin County in Section 5D.1.

McLendon-Chisholm

McLendon-Chisholm is located in southern Rockwall County and has a population of about 1,800. Residents of the city get retail water service from High Point WSC and R-C-H WSC, both of which get their water from NTMWD. The water management strategies for McLendon-Chisholm are conservation and additional water from NTMWD. Table 5D.305 shows the projected population and demand, the current supplies, and the water management strategies for McLendon-Chisholm.

Table 5D.305
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of McLendon-Chisholm

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,739**	**2,188**	**2,698**	**3,215**	**3,792**	**4,403**
Projected Water Demand						
Municipal Demand	330	406	495	587	691	802
Total Projected Demand	***330***	***406***	***495***	***587***	***691***	***802***
Currently Available Water Supplies						
North Texas Municipal Water District (through High Point WSC and RCH WSC)	229	233	254	268	285	296
Total Current Supplies	***229***	***233***	***254***	***268***	***285***	***296***
Need (Demand - Current Supply)	***101***	***173***	***241***	***319***	***406***	***506***
Water Management Strategies						
Water Conservation	6	10	15	20	25	32
Additional Water from NTMWD (through High Point WSC and RCH WSC)	95	163	226	299	381	474
Total Water Management Strategies	***101***	***173***	***241***	***319***	***406***	***506***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Mount Zion Water Supply Corporation

Mount Zion WSC serves about 1,700 people in northern Rockwall County. The WSC gets its water supply from NTMWD through the city of Rockwall. Water management strategies for Mount Zion WSC include conservation and additional water from NTMWD through Rockwall. Table 5D.306 shows the projected population and demand, the current supplies, and the water management strategies for Mount Zion WSC.

Table 5D.306
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Mount Zion Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,985**	**2,497**	**3,080**	**3,669**	**4,327**	**5,025**

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand						
Municipal Demand	395	485	589	698	822	954
Total Projected Demand	***395***	***485***	***589***	***698***	***822***	***954***
Currently Available Water Supplies						
NTMWD (through Rockwall)	364	372	416	465	513	551
Total Current Supplies	***364***	***372***	***416***	***465***	***513***	***551***
Need (Demand - Current Supply)	***31***	***113***	***173***	***233***	***309***	***403***
Water Management Strategies						
Water Conservation	7	12	18	23	30	38
Add'l NTMWD (through Rockwall)	24	101	155	210	279	365
Total Water Management Strategies	***31***	***113***	***173***	***233***	***309***	***403***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rockwall

Rockwall is located in central Rockwall County and has a population of about 36,000 people. Rockwall is a wholesale water provider, and the discussion of water supply plans for Rockwall is in Section 5C.2.

Rockwall County Irrigation

Table 5D.307 shows the projected demand, the current supplies, and the water management strategies for Rockwall County Irrigation. The current supplies are reuse from NTMWD and water from Dallas Water Utilities (DWU). The water management strategies are conservation and additional water from NTWMD and DWU.

Table 5D.307
Projected Demand, Current Supplies,
and Water Management Strategies for the Rockwall County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**374**	**374**	**374**	**374**	**374**	**374**
Currently Available Water Supplies						
Direct Reuse (NTWMD)	672	672	672	672	672	672
Dallas Water Utilities	264	240	215	198	185	176
Total Current Supplies	***936***	***912***	***887***	***870***	***857***	***848***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	1	12	24	30	35	41
Water from NTWMD	97	94	91	89	88	86
Additional Water from DWU	12	28	44	57	66	71
Total Water Management Strategies	***110***	***134***	***159***	***176***	***189***	***198***
Reserve (Shortage)	**672**	**672**	**672**	**672**	**672**	**672**

Rockwall County Livestock

Table 5D.308 shows the projected demand, current supplies, and water management strategies for Rockwall County Livestock. The current supply is local surface water supplies. This source is sufficient to meet projected demands, and there are no water management strategy for this water user group.

Table 5D.308
Projected Demand, Current Supplies,
and Water Management Strategies for the Rockwall County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**117**	**117**	**117**	**117**	**117**	**117**
Currently Available Water Supplies						
Local Supplies	117	117	117	117	117	117
Total Current Supplies	***117***	***117***	***117***	***117***	***117***	***117***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rockwall County Manufacturing

Table 5D.309 shows the projected demand and current supplies for Rockwall County Manufacturing. Current supplies are from Rockwall, which is supplied by NTMWD. The water management strategies for this water user group are conservation and additional water from NTMWD.

Table 5D.309
Projected Demand, Current Supplies, and Water Management Strategies for the Rockwall County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**35**	**40**	**45**	**50**	**55**	**61**
Currently Available Water Supplies						
NTWMD (through Rockwall)	32	31	32	33	34	35
Total Current Supplies	***32***	***31***	***32***	***33***	***34***	***35***
Need (Demand - Current Supply)	***3***	***9***	***13***	***17***	***21***	***26***
Water Management Strategies						
Water Conservation	0	0	1	1	2	2
Additional water from NTMWD	3	9	12	16	19	24
Total Water Management Strategies	***3***	***9***	***13***	***17***	***21***	***26***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rockwall County Mining

Table 5D.310 shows the projected demand, the current supplies, and the water management strategies for Rockwall County Mining. There is no demand, supply or no water management strategies for this water user group.

Table 5D.310
Projected Demand, Current Supplies, and Water Management Strategies for the Rockwall County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**0**	**0**	**0**	**0**	**0**	**0**
Currently Available Water Supplies						
None	0	0	0	0	0	0
Total Current Supplies	***0***	***0***	***0***	***0***	***0***	***0***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rockwall County Other

Rockwall County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. The entities included under Rockwall County Other supply about 3,500 people, and the population is expected to grow. Rockwall County Other gets its water supply from NTMWD through various customers of NTWMD. Water management strategies for these entities include conservation and additional water from NTMWD. Table 5D.311 shows the projected population and demand, the current supplies, and the water management strategies for Rockwall County Other.

Table 5D.311
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Rockwall County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,527**	**3,527**	**3,527**	**3,527**	**12,000**	**20,000**
Projected Water Demand						
Municipal Demand	568	564	562	560	1,886	3,139
Total Projected Water Demand	***568***	***564***	***562***	***560***	***1,886***	***3,139***
Currently Available Water Supplies						
NTWMD (through various providers)	523	432	397	373	1,177	1,813
Total Current Supplies	***523***	***432***	***397***	***373***	***1,177***	***1,813***
Need (Demand - Current Supply)	***45***	***132***	***165***	***187***	***709***	***1,326***
Water Management Strategies						
Water Conservation	5	7	6	7	31	63
Additional Water from NTMWD	40	125	159	180	678	1,263
Total Water Management Strategies	***45***	***132***	***165***	***187***	***709***	***1,326***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Rockwall County Steam Electric Power

There is no projected demand for Rockwall County Steam Electric Power.

Rowlett

Rowlett is a city of about 59,000 located in northeastern Dallas County and Rockwall County. Water management strategies for Rowlett are discussed under Dallas County in Section 5D.3.

Royse City

Royse City is a city of about 10,000 people located in northeast Rockwall County and southeast Collin County. The city gets its water supply from NTMWD. The water management strategies for Royse City are conservation and additional water from NTMWD. Table 5D.312 shows the projected population and demand, the current supplies, and the water management strategies for Royse City.

Table 5D.312
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Royse City

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**10,864**	**15,452**	**23,572**	**45,737**	**80,973**	**91,316**
Projected Water Demand						
Municipal Demand	1,261	1,746	2,628	5,065	8,948	10,089
Total Projected Demand	***1,261***	***1,746***	***2,628***	***5,065***	***8,948***	***10,089***
Currently Available Water Supplies						
NTMWD	1,122	1,298	1,811	3,318	5,516	5,742
Total Current Supplies	***1,122***	***1,298***	***1,811***	***3,318***	***5,516***	***5,742***
Need (Demand - Current Supply)	***139***	***448***	***817***	***1,747***	***3,432***	***4,347***
Water Management Strategies						
Water Conservation	10	17	26	66	147	199
Additional Water from NTMWD	129	431	791	1,681	3,285	4,148
Total Water Management Strategies	***139***	***448***	***817***	***1,747***	***3,432***	***4,347***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wylie

Wylie is city of about 44,300 located in southern Collin County with small areas in Dallas and Rockwall Counties. Wylie's water supply plans are discussed under Collin County in Section 5D.1.

Costs for Rockwall County Water User Groups

Table 5D.313 shows the estimated capital costs for Rockwall County water management strategies not covered under the wholesale water providers. Table 5D.314 summarizes the costs by category and is followed by a summary for Rockwall County.

Table 5D.313
Costs for Recommended Water Management Strategies for Rockwall County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Blackland WSC*	Conservation	2020	36	$257,334	$5.35	$1.12	Q-10
	Additional NTMWD	2020	356	$0	$1.75	$1.75	None
	Direct Connection to NTMWD	*2020*	*356*	$3,295,550	$1.25	$0.20	Q-179
Cash SUD*	Conservation	2020	7	$1,928	$0.50	$0.00	Q-10
	Additional SRA	See Region D plan for costs.					
	Additional NTMWD	2020	1,165	$0	$1.75	$1.75	None
	Increase delivery infrastructure from NTWMD	*2020*	*1,165*	$6,654,700	$1.63	$0.16	Q-180
	Water Treatment Plant Expansions	See Region D plan for costs.					
Dallas*	Conservation	See Dallas County.					
	Other measures	See DWU in Section 5C.					
East Fork SUD*	Conservation	See Collin County.					
	Additional NTMWD	See Collin County.					
Fate	Conservation	2020	312	$116,210	$3.52	$0.91	Q-10
	Additional NTMWD	2020	2,982	$0	$1.75	$1.75	None
	Increase delivery infrastructure from NTMWD	*2060*	*2,982*	$15,075,000	$1.62	$0.32	Q-182
Forney Lake WSC*	Conservation	See Kaufman County.					
	Additional NTMWD	See Kaufman County.					
Garland*	Conservation	See Dallas County.					
	Additional NTMWD	See Garland in Section 5C.					
Heath	Conservation	2020	340	$687,506	$3.71	$0.63	Q-10
	Additional NTMWD	2020	2,962	$0	$1.75	$1.75	None
High Point WSC*	Conservation	See Kaufman County.					
	Additional NTMWD	See Kaufman County.					
Lavon SUD	Conservation	See Collin County.					
	Additional NTMWD	See Collin County.					
McLendon-Chisholm	Conservation	2020	32	$11,013	$3.03	$1.18	Q-10
	Additional NTMWD	2020	474	$0	$1.75	$1.75	None
	Conservation	2020	38	$38,667	$3.64	$1.13	Q-10

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Mount Zion WSC	Additional NTMWD	2020	365	$0	$1.75	$1.75	None
Rockwall	Conservation	2020	1,286	$409,483	$1.27	$0.44	Q-10
	Other measures	See Rockwall in Section 5C.2.					
Rockwall County Other	Conservation	2020	63	$12,200	$0.63	$0.00	Q-10
	Additional NTMWD	2020	1,263	$0	$1.75	$1.75	None
Rowlett*	Conservation	See Dallas County.					
	Additional NTMWD	See Dallas County.					
Royse City*	Conservation	2020	199	$26,487	$0.68	$0.00	Q-10
	Additional NTMWD	2020	4,148	$0	$1.70	$1.70	None
Wylie*	Conservation	See Collin County.					
	Additional NTMWD	See Collin County.					
Rockwall County Irrigation	Conservation	2020	41	$0	$0.95	$0.95	Q-11
	Additional NTWMD	2020	97	$0	$1.75	$1.75	None
	Additional DWU	2020	71	$0	$1.48	$1.48	None
Rockwall County Livestock	None	N/A	N/A	N/A	N/A	N/A	N/A
Rockwall County Manufacturing	Conservation	2040	2	$0	$0.95	$0.95	Q-11
	Additional NTMWD	2020	24	$0	$1.25	$1.25	None
Rockwall County Mining	None	N/A	N/A	N/A	N/A	N/A	N/A
Rockwall County Steam Electric	None	N/A	N/A	N/A	N/A	N/A	N/A

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.314
Summary of Recommended Water Management Strategies
for Rockwall County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	2,356	$1,560,828
Purchase from WWP	13,907	$0
Delivery infrastructure	*4,503*	$25,025,250
Total		**$26,586,078**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

2010 Population: *78,337*

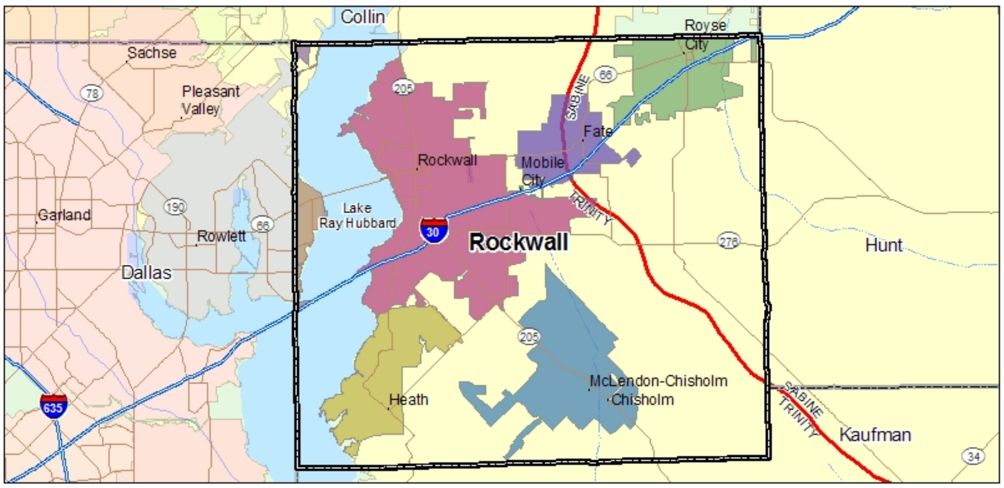
Projected 2070 Population: *301,970*

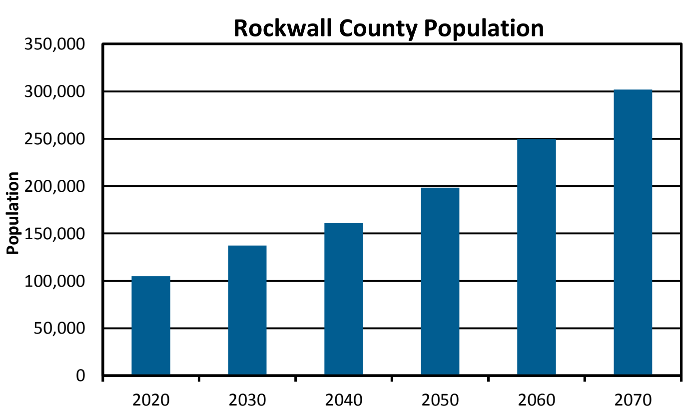
County Seat: Rockwall

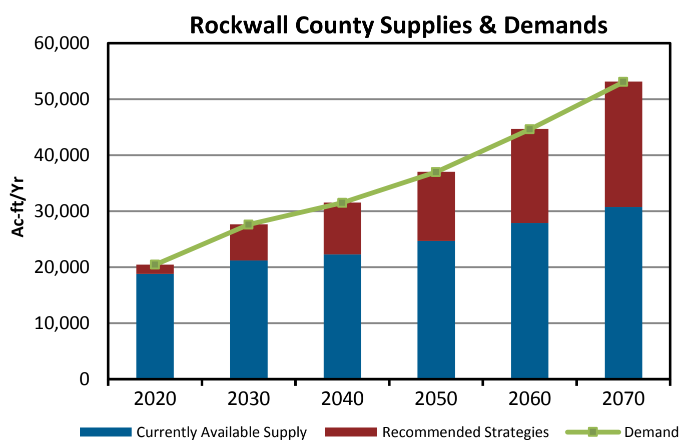
Economy: Industry

River Basin(s):

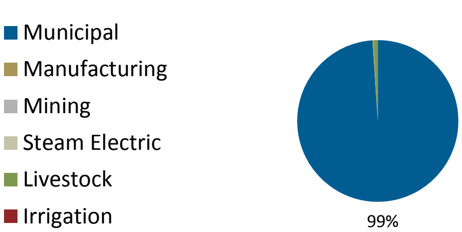
- Trinity (76%), Sabine (24%)





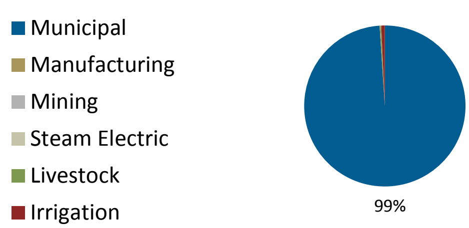


2010 Rockwall County Historical Demand
(% of total)



Total= 12,986 acre-feet

2070 Rockwall County Projected Demand
(% of total)



Total= 53,074 acre-feet

5D.15 Tarrant County

Figure 5D.15 is a map of Tarrant County. Tarrant County is in the Northern Trinity Groundwater Conservation District. Most Tarrant County water supplies come from raw water provided by the Tarrant Regional Water District (TRWD). Fort Worth, Arlington, Mansfield, and the Trinity River Authority have major water treatment plants, and a number of smaller water user groups purchase water from these major suppliers. Azle, Benbrook Water and Sewer Authority (supplying Benbrook), Community Water Supply Corporation, Grapevine and River Oaks operate smaller water treatment plants. A number of Tarrant County suppliers use groundwater for all or part of their supply. The demands in Tarrant County are projected to increase significantly, which will require additional water treatment plant capacity (new plants and expansions) and increased supplies from TRWD.

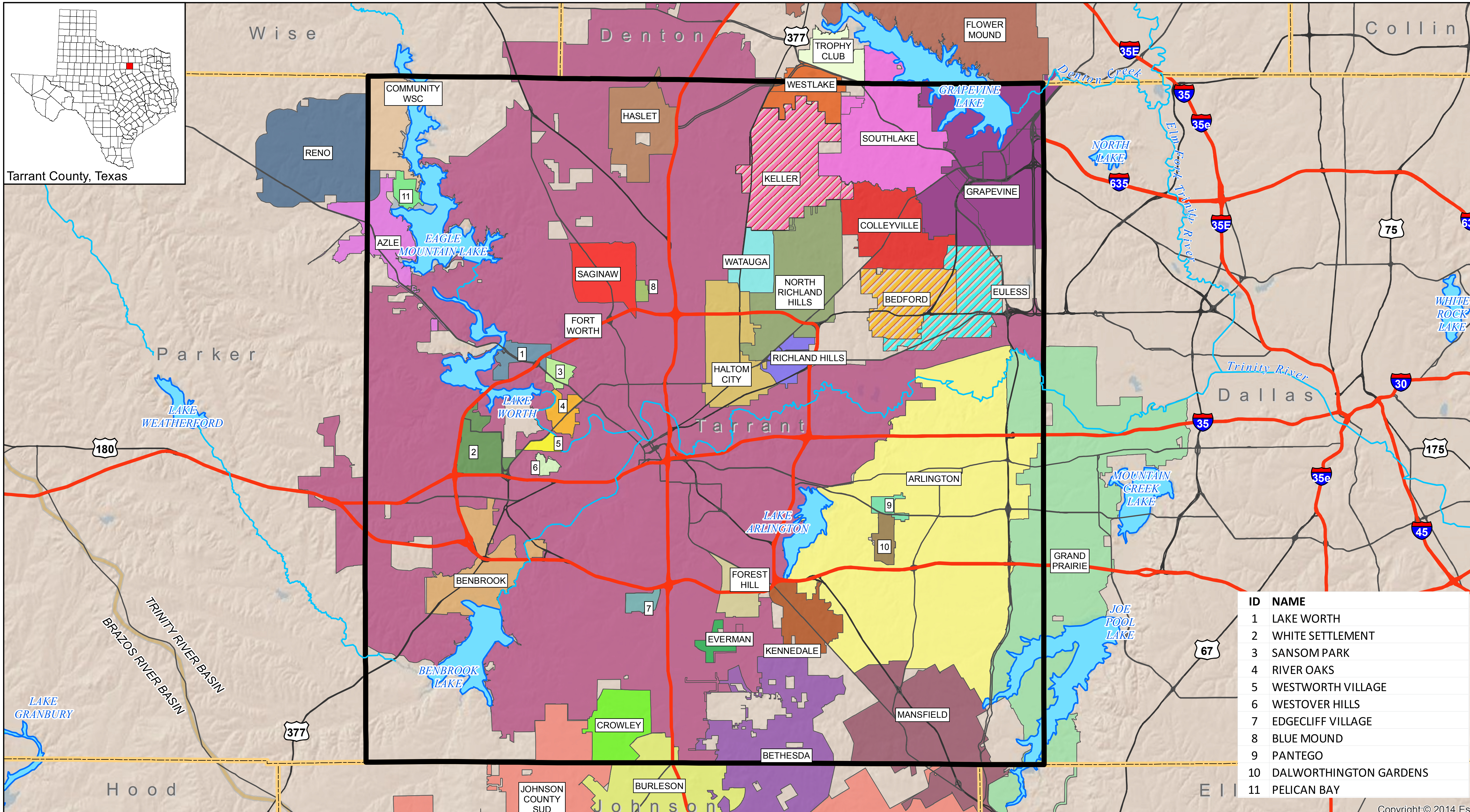
Water management strategies for Tarrant County water user groups are discussed on the following pages (in alphabetical order). Table 5D.355 shows the estimated capital costs for the Tarrant County recommended water management strategies not associated with the wholesale water providers, and Table 5D.356 is a summary of the costs by category. Table 5D.357 shows the estimated capital costs for the Tarrant County alternative water management strategies not associated with the wholesale water providers. Table 5D.357 is followed by a Tarrant County summary.

Arlington

Arlington is a city of about 378,000 people located in eastern Tarrant County. Arlington is a wholesale water provider, and the discussion of water supply plans for Arlington is in Section 5C.2.

Azle

Azle has a population of about 11,000 and is located in northwestern Tarrant and northeastern Parker Counties. Azle purchases and treats raw water from TRWD. Water management strategies for the city are conservation, water treatment plant expansions, and more water from TRWD. Table 5D.315 shows the projected population and demand, the current supplies, and the water management strategies for Azle.



FREESE AND NICHOLS

Project No: NTD11336

Service Area
County Boundary
Tarrant County Boundary
River Basin Divide
River
Reservoir

N S E W

1 inch = 4 miles

0 2 4 8

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Tarrant County, Texas

Figure 5D.15

Table 5D.315
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Azle

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**11,857**	**12,854**	**13,868**	**14,897**	**18,000**	**23,090**
Projected Water Demand						
Municipal Demand	1,858	1,958	2,068	2,198	2,647	3,390
Total Projected Demand	***1,858***	***1,958***	***2,068***	***2,198***	***2,647***	***3,390***
Currently Available Water Supplies						
Tarrant Regional Water District (limited by treatment plant capacity)	1,682	1,682	1,664	1,562	1,678	1,682
Total Current Supplies	***1,682***	***1,682***	***1,664***	***1,562***	***1,678***	***1,682***
Need (Demand - Current Supply)	***177***	***277***	***404***	***636***	***969***	***1,709***
Water Management Strategies						
Water Conservation	15	22	21	29	44	68
Additional Raw Water Needed from TRWD with treatment as below:	162	255	383	607	925	1,641
3 MGD WTP Expansion (TRWD)	*162*	*255*	*383*	*607*	*925*	*1,641*
Total Water Management Strategies	***177***	***277***	***404***	***636***	***969***	***1,709***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Bedford

Bedford is located in northeastern Tarrant County and has a population of about 48,000. The city's water supply is groundwater (Trinity aquifer) and treated water from the Trinity River Authority (TRA), which gets raw water from TRWD. Water management strategies include conservation and additional water from TRA. It should be noted that Bedford is undertaking a large conservation strategy of replacing mains that are a significant sources of water loss. More information on this is contained in Appendix K. Table 5D.316 shows the projected population and demand, the current supplies, and the water management strategies for Bedford.

Table 5D.316
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Bedford

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**48,100**	**51,983**	**55,866**	**59,750**	**59,750**	**59,750**
Projected Water Demand						
Municipal Demand	9,139	9,612	10,121	10,711	10,694	10,694
Total Projected Demand	***9,139***	***9,612***	***10,121***	***10,711***	***10,694***	***10,694***
Currently Available Water Supplies						
Trinity Aquifer	725	725	725	725	725	725
Trinity River Authority (TRWD)	8,414	8,088	7,558	7,098	6,320	5,641
Total Current Supplies	***9,139***	***8,813***	***8,283***	***7,823***	***7,045***	***6,366***
Need (Demand - Current Supply)	***0***	***799***	***1,838***	***2,888***	***3,649***	***4,328***
Water Management Strategies						
Water Conservation	1,036	1,122	304	357	392	428
Additional Water from TRA (TRWD)	0	0	1,534	2,531	3,257	3,900
Total Water Management Strategies	***1,036***	***1,122***	***1,838***	***2,888***	***3,649***	***4,328***
Reserve (Shortage)	**1,036**	**323**	**0**	**0**	**0**	**0**

Benbrook

Benbrook is a city of about 22,000 people located in southwestern Tarrant County. The city's water supply is raw water from TRWD (treated at Benbrook's own water treatment plant) and groundwater (Trinity aquifer). Water management strategies are conservation, water treatment plant expansions, and additional water from TRWD. Table 5D.317 shows the projected population and demand, the current supplies, and the water management strategies for Benbrook.

Table 5D.317
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Benbrook

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**22,500**	**25,000**	**27,500**	**32,833**	**48,095**	**48,095**
Projected Water Demand						
Municipal Demand	5,205	5,659	6,130	7,258	10,605	10,605
Total Projected Demand	***5,205***	***5,659***	***6,130***	***7,258***	***10,605***	***10,605***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Trinity Aquifer	1,060	1,060	1,060	1,060	1,060	1,060
Tarrant Regional Water District (limited by contract)	3,385	3,385	3,385	3,385	3,385	3,385
Total Current Supplies	***4,445***	***4,445***	***4,445***	***4,445***	***4,445***	***4,445***
Need (Demand - Current Supply)	***760***	***1,214***	***1,685***	***2,813***	***6,160***	***6,160***
Water Management Strategies						
Water Conservation	112	186	227	296	477	512
Additional Raw Water Needed from TRWD beyond current contract with treatment as below:	648	1,028	1,458	2,517	5,683	5,648
4.25 MGD WT Plant Expansion					*2,342*	*2,307*
Total Water Management Strategies	***760***	***1,214***	***1,685***	***2,813***	***6,160***	***6,160***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Bethesda Water Supply Corporation

Bethesda WSC serves an estimated 29,000 people in southern Tarrant County and northern Johnson County. (Johnson County is in the Brazos G water planning region.) Most of the WSC's service area is located in Region G, and the 2016 Brazos G Regional Water Plan will also have detail on strategies for this WUG. Bethesda WSC's water supplies are treated water from Fort Worth (which gets its raw water from TRWD) and groundwater from the Trinity aquifer (in both Regions C and G). Water management strategies for Bethesda WSC include conservation, additional water from Fort Worth, and connecting to and purchasing water from Arlington (which gets raw water from TRWD). Table 5D.318 shows the projected population and demand, the current supplies, and the water management strategies for Bethesda WSC. It should be noted that the 2020 population projection for Bethesda WSC shown in the Regional plans is somewhat lower than what Bethesda WSC estimates it currently serves. Consequently, Bethesda WSC uses higher projections for its own internal planning. Additional water from Fort Worth has been allocated to Bethesda WSC in the plan to account for this additional population. This additional allocation shows up in the table below as a reserve.

Table 5D.318
Projected Population and Demand, Current Supplies, and Water Management Strategies for Bethesda Water Supply Corporation (Regions C and G)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**24,614**	**28,132**	**31,713**	**35,503**	**39,507**	**43,693**
Projected Water Demand						
Municipal Demand	5,162	5,772	6,415	7,132	7,923	8,758
Total Projected Water Demand	***5,162***	***5,772***	***6,415***	***7,132***	***7,923***	***8,758***
Currently Available Water Supplies						
Trinity Aquifer (Region C)	305	305	305	305	305	305
Trinity Aquifer (Region G)	1,979	1,979	1,979	1,979	1,979	1,979
Fort Worth (TRWD)	1,405	1,507	1,571	1,709	1,861	1,999
Total Current Supplies	***3,689***	***3,791***	***3,855***	***3,993***	***4,145***	***4,283***
Need (Demand - Current Supply)	***1,473***	***1,981***	***2,560***	***3,139***	***3,778***	***4,475***
Water Management Strategies						
Water Conservation	35	55	69	83	99	117
Additional Water from Fort Worth	1,054	1,461	1,941	2,410	2,928	3,496
Connect to Arlington (TRWD)	1,416	1,619	1,833	2,072	2,336	2,614
Total Water Management Strategies	***2,505***	***3,135***	***3,843***	***4,565***	***5,363***	***6,227***
Reserve (Shortage)	**1,032**	**1,154**	**1,283**	**1,426**	**1,585**	**1,752**

Blue Mound

Blue Mound has a population of about 2,400 and is located in northern Tarrant County. The city has historically been served by a private water company (Monarch Utilities) that uses groundwater from the Trinity aquifer. In September 2015, the city purchased the water system from Monarch. Since this purchase occurred after the Region C June 2015 date to be considered “existing” supply, it is being shown as a strategy in this plan. The only water management strategies for Blue Mound are conservation and the purchase of the water system from Monarch Utilities. Table 5D.319 shows the projected population and demand, the current supplies, and the water management strategies for Blue Mound.

Table 5D.319
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Blue Mound

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,398**	**2,403**	**2,408**	**2,413**	**2,418**	**2,422**
Projected Water Demand						
Municipal Demand	191	181	172	167	167	167
Total Projected Water Demand	***191***	***181***	***172***	***167***	***167***	***167***
Currently Available Water Supplies						
Trinity Aquifer	191	191	191	191	191	191
Total Current Supplies	***191***	***191***	***191***	***191***	***191***	***191***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	2	2	2	3	3
Purchase existing water system from Monarch Utilities	*0*	*0*	*0*	*0*	*0*	*0*
Total Water Management Strategies	***2***	***2***	***2***	***2***	***3***	***3***
Reserve (Shortage)	**2**	**12**	**21**	**26**	**27**	**27**

Burleson

Burleson is a city of about 40,000 people located in southern Tarrant County and northern Johnson County. (Johnson County is in the Brazos G water planning region.) Most of Burleson's service area is located in Region G, and the 2016 Brazos G Regional Water Plan will also have detail on strategies for this WUG. The city provides water to a small portion of Johnson County Manufacturing. The city's water supply is treated water from Fort Worth, which gets its raw water from TRWD. Water management strategies for Burleson are conservation, additional water from Fort Worth, and an additional connection to Fort Worth to increase delivery capacity. Table 5D.320 shows the projected population and demand, the current supplies, and the water management strategies for Burleson. It should be noted that the demand projections for Burleson shown in the Regional plans are somewhat lower than what Burleson projects in its current master plan. Consequently, an amount greater than the demand has been allocated from Fort Worth, resulting in a "reserve" in this plan.

Table 5D.320
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Burleson (Regions C and G)

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**43,801**	**51,845**	**60,022**	**68,635**	**77,711**	**87,170**
Projected Water Demand						
Municipal Demand	6,620	7,664	8,757	9,950	11,241	12,602
Johnson County Manufacturing	2	2	2	2	2	2
Total Projected Water Demand	***6,622***	***7,666***	***8,759***	***9,952***	***11,243***	***12,604***
Currently Available Water Supplies						
Fort Worth (TRWD)	4,826	4,826	4,826	4,826	4,826	4,826
Total Current Supplies	***4,826***	***4,826***	***4,826***	***4,826***	***4,826***	***4,826***
Need (Demand - Current Supply)	***1,796***	***2,840***	***3,933***	***5,126***	***6,417***	***7,778***
Water Management Strategies						
Water Conservation	11	15	15	27	41	55
Additional Water from Fort Worth	3,109	4,358	5,670	7,089	8,625	10,244
Increase delivery capacity from Ft Worth	*0*	*0*	*967*	*2,386*	*3,922*	*5,541*
Total Water Management Strategies	***3,120***	***4,373***	***5,685***	***7,116***	***8,666***	***10,299***
Reserve (Shortage)	**1,324**	**1,533**	**1,752**	**1,990**	**2,249**	**2,521**

Colleyville

Colleyville has a population of about 24,000 and is located in northeastern Tarrant County. The city's water supply is treated water from the Trinity River Authority (TRA), which gets raw water from TRWD. Colleyville's water management strategies are conservation and additional water from TRA. Table 5D.321 shows the projected population and demand, the current supplies, and the water management strategies for Colleyville.

Table 5D.321
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Colleyville

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**24,000**	**25,500**	**27,000**	**28,000**	**28,000**	**28,000**
Projected Water Demand						
Municipal Demand	9,320	9,808	10,314	10,657	10,649	10,648
Total Projected Water Demand	***9,320***	***9,808***	***10,314***	***10,657***	***10,649***	***10,648***
Currently Available Water Supplies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Trinity River Authority (TRWD)	9,320	8,927	8,297	7,575	6,751	6,025
Total Current Supplies	***9,320***	***8,927***	***8,297***	***7,575***	***6,751***	***6,025***
Need (Demand - Current Supply)	***0***	***881***	***2,017***	***3,082***	***3,898***	***4,623***
Water Management Strategies						
Water Conservation	171	259	309	355	390	426
Additional Water from TRA	0	622	1,708	2,727	3,508	4,197
Total Water Management Strategies	***171***	***881***	***2,017***	***3,082***	***3,898***	***4,623***
Reserve (Shortage)	**171**	**0**	**0**	**0**	**0**	**0**

Community Water Supply Corporation

Community WSC serves about 3,500 people in northwestern Tarrant County and southern Wise County. The WSC gets raw water from TRWD and operates its own water treatment plant. Water management strategies for Community WSC include conservation and additional water from TRWD. Table 5D.322 shows the projected population and demand, the current supplies, and the water management strategies for Community WSC.

Table 5D.322
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Community Water Supply Corporation

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**3,498**	**3,933**	**4,363**	**4,781**	**5,200**	**5,610**
Projected Water Demand						
Municipal Demand	347	369	394	430	466	502
Total Projected Water Demand	***347***	***369***	***394***	***430***	***466***	***502***
Currently Available Water Supplies						
TRWD	347	336	317	306	295	284
Total Current Supplies	***347***	***336***	***317***	***306***	***295***	***284***
Need (Demand - Current Supply)	***0***	***33***	***77***	***124***	***171***	***218***
Water Management Strategies						
Water Conservation	3	4	4	6	8	10
Additional Water from TRWD	0	29	73	118	163	208
Total Water Management Strategies	***3***	***33***	***77***	***124***	***171***	***218***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Crowley

Crowley is a city of about 14,000 people located in southern Tarrant County. The city's water supply is treated water from Fort Worth (which gets its raw water from TRWD) and groundwater from the Trinity aquifer. Water management strategies for Crowley are conservation, additional water from Fort Worth, and an additional connection to Fort Worth (increase delivery infrastructure). Table 5D.323 shows the projected population and demand, the current supplies, and the water management strategies for Crowley.

Table 5D.323
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Crowley

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**16,362**	**19,142**	**22,883**	**27,525**	**35,213**	**40,258**
Projected Water Demand						
Municipal Demand	2,427	2,776	3,273	3,911	4,992	5,703
Total Projected Water Demand	***2,427***	***2,776***	***3,273***	***3,911***	***4,992***	***5,703***
Currently Available Water Supplies						
Trinity Aquifer	320	320	320	320	320	320
Fort Worth (TRWD)	1,682	1,681	1,682	1,682	1,681	1,682
Total Current Supplies	***2,002***	***2,001***	***2,002***	***2,002***	***2,001***	***2,002***
Need (Demand - Current Supply)	***425***	***775***	***1,271***	***1,909***	***2,991***	***3,701***
Water Management Strategies						
Water Conservation	20	30	33	52	83	113
Additional Water from TRWD	405	745	1,238	1,857	2,908	3,588
Increase delivery infrastructure from Ft Worth in future	*0*	*184*	*678*	*1,297*	*2,347*	*3,028*
Total Water Management Strategies	***425***	***775***	***1,271***	***1,909***	***2,991***	***3,701***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Dalworthington Gardens

Dalworthington Gardens has a population of about 2,300 and is located in eastern Tarrant County. The city's water supply is treated water from Fort Worth (which gets its raw water from TRWD) and groundwater from the Trinity aquifer. Water management strategies for Dalworthington Gardens are conservation and additional water from Fort Worth. Table 5D.324 shows the projected population and demand, the current supplies, and the water management strategies for Dalworthington Gardens.

Table 5D.324
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Dalworthington Gardens

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,307**	**2,359**	**2,410**	**2,460**	**2,510**	**2,559**
Projected Water Demand						
Municipal Demand	912	922	933	947	966	984
Total Projected Water Demand	***912***	***922***	***933***	***947***	***966***	***984***
Currently Available Water Supplies						
Trinity Aquifer	325	325	325	325	325	325
Fort Worth (TRWD)	570	481	416	383	361	341
Total Current Supplies	***895***	***806***	***741***	***708***	***686***	***666***
Need (Demand - Current Supply)	***17***	***116***	***192***	***239***	***280***	***318***
Water Management Strategies						
Water Conservation	17	25	28	32	35	39
Additional Water from Fort Worth	0	91	164	207	245	279
Total Water Management Strategies	***17***	***116***	***192***	***239***	***280***	***318***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Edgecliff

Edgecliff (or Edgecliff Village) is located in southern Tarrant County and has a population of about 2,900. The city's water supply is treated water from Fort Worth, which gets raw water from TRWD. Water management strategies for Edgecliff include conservation and additional water Fort Worth. Table 5D.325 shows the projected population and demand, the current supplies, and the water management strategies for Edgecliff.

Table 5D.325
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Edgecliff

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,924**	**2,924**	**2,924**	**2,924**	**2,924**	**2,924**
Projected Water Demand						
Municipal Demand	503	491	480	475	474	474
Total Projected Demand	***503***	***491***	***480***	***475***	***474***	***474***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Currently Available Water Supplies						
Fort Worth (TRWD)	494	396	328	292	267	245
Total Current Supplies	***494***	***396***	***328***	***292***	***267***	***245***
Need (Demand - Current Supply)	***9***	***95***	***152***	***183***	***207***	***229***
Water Management Strategies						
Water Conservation	9	13	14	16	17	19
Additional Water from Fort Worth	0	82	138	167	190	210
Total Water Management Strategies	***9***	***95***	***152***	***183***	***207***	***229***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Euless

Euless has a population of about 54,000 and is located in northeastern Tarrant County. The city's water supply is groundwater (Trinity aquifer), treated water from the Trinity River Authority (TRA), which gets raw water from TRWD, and Fort Worth direct reuse. Euless' water management strategies are conservation and additional water from TRA. Table 5D.326 shows the projected population and demand, the current supplies, and the water management strategies for Euless. In the future, Euless may take their current groundwater wells out of service, so an alternative strategy for Euless is to increase treated water purchase from TRA to replace existing groundwater supply. Also, in the future Euless may begin providing water service to a portion of the DFW International Airport, which is part of the WUG Tarrant County Other. See Table 5D.348 for more details.

Table 5D.326
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Euless

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**54,214**	**57,150**	**57,150**	**57,150**	**57,150**	**57,150**
Projected Water Demand						
Municipal Demand	8,978	9,212	9,031	8,932	8,913	8,913
Total Projected Demand	***8,978***	***9,212***	***9,031***	***8,932***	***8,913***	***8,913***
Currently Available Water Supplies						
Fort Worth Direct Reuse	368	368	368	368	368	368
Trinity Aquifer	1,211	1,211	1,211	1,211	1,211	1,211
Trinity River Authority (TRWD)	7,399	6,947	5,995	5,226	4,650	4,150
Total Current Supplies	***8,978***	***8,526***	***7,574***	***6,805***	***6,229***	***5,729***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***0***	***686***	***1,457***	***2,127***	***2,684***	***3,184***
Water Management Strategies						
Water Conservation	178	274	300	119	149	178
Additional Water from TRA (TRWD)	0	412	1,157	2,008	2,535	3,006
Total Water Management Strategies	***178***	***686***	***1,457***	***2,127***	***2,684***	***3,184***
Reserve (Shortage)	**178**	**0**	**0**	**0**	**0**	**0**
Alternative Water Management Strategies						
Add'l TRA (TRWD) to replace groundwater	1,211	1,211	1,211	1,211	1,211	1,211

Everman

Everman is located in southern Tarrant County and has a population of about 6,100. The city's water supply is groundwater from the Trinity aquifer. Water management strategy for Everman is conservation. Table 5D.327 shows the projected population and demand, the current supplies, and the water management strategies for Everman.

Table 5D.327
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Everman

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**6,286**	**6,477**	**6,600**	**6,600**	**6,600**	**6,600**
Projected Water Demand						
Municipal Demand	541	528	514	501	499	499
Total Projected Demand	***541***	***528***	***514***	***501***	***499***	***499***
Currently Available Water Supplies						
Trinity Aquifer	604	604	604	604	604	604
Total Current Supplies	***604***	***604***	***604***	***604***	***604***	***604***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	5	6	5	7	8	10
Total Water Management Strategies	***5***	***6***	***5***	***7***	***8***	***10***
Reserve (Shortage)	**68**	**82**	**95**	**110**	**113**	**115**

Forest Hill

Forest Hill is a city of about 12,400 people located in southern Tarrant County. The city's water supply is treated water from Fort Worth, which gets its raw water from TRWD. Water management strategies for Forest Hill are conservation and additional water from Fort Worth. Table 5D.328 shows the projected population and demand, the current supplies, and the water management strategies for Forest Hill.

Table 5D.328
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Forest Hill

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**13,000**	**13,788**	**15,000**	**18,000**	**23,000**	**30,000**
Projected Water Demand						
Municipal Demand	1,362	1,381	1,448	1,703	2,164	2,817
Total Projected Demand	***1,362***	***1,381***	***1,448***	***1,703***	***2,164***	***2,817***
Currently Available Water Supplies						
Fort Worth (TRWD)	1,351	1,114	990	1,048	1,219	1,459
Total Current Supplies	***1,351***	***1,114***	***990***	***1,048***	***1,219***	***1,459***
Need (Demand - Current Supply)	***11***	***267***	***458***	***655***	***945***	***1,358***
Water Management Strategies						
Water Conservation	11	16	14	23	36	56
Additional Water from Fort Worth	0	251	444	632	909	1,302
Total Water Management Strategies	***11***	***267***	***458***	***655***	***945***	***1,358***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fort Worth

Fort Worth is a city of about 781,000 located primarily in Tarrant County, with some population in Denton, Parker, and Wise Counties in Region C and in Johnson County in Region G. Fort Worth is a wholesale water provider, and the city's water supply plans are discussed in Section 5C.1.

Grand Prairie

Grand Prairie is a city of about 181,000 in western Dallas County, eastern Tarrant County, and northwestern Ellis County. The city is a wholesale water provider, and there is a discussion of Grand Prairie's water supply plans in Section 5C.2.

Grapevine

Grapevine is located in northeastern Tarrant County and has a population of about 48,000. The city gets its water supply from multiple sources – treated water from TRA (which gets raw water from TRWD), raw water from Lake Grapevine (based on the city's portion of the firm yield), Dallas (DWU), and indirect reuse from Lake Grapevine purchased from Dallas County Park Cities MUD. Water management strategies for Grapevine include conservation, additional water from TRA, and additional water from Dallas (with only a very small increase above what is currently being purchased from Dallas). An alternative water management strategy for Grapevine would be to purchase a portion of Dallas County Park Cities MUD's unused supply from Lake Grapevine yield. Grapevine does not require any additional infrastructure to take delivery or to treat their supplies in the future (beyond maintenance of existing facilities). Table 5D.329 shows the projected population and demand, the current supplies, and the water management strategies for Grapevine.

Table 5D.329
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Grapevine

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**52,414**	**58,930**	**60,000**	**60,000**	**60,000**	**60,000**
Projected Water Demand						
Municipal Demand	18,467	20,509	20,725	20,641	20,624	20,623
Golf Course (Tarrant County Irrigation)	1,121	1,121	1,121	1,121	1,121	1,121
Total Projected Demand	***19,588***	***21,630***	***21,846***	***21,762***	***21,745***	***21,744***
Currently Available Water Supplies						
Dallas Water Utilities	3,402	3,409	3,141	2,823	2,608	2,461
Indirect Reuse (Purchased from DCPCMUD)	3,311	3,677	3,716	3,701	3,698	3,698
Trinity River Authority (TRWD)	10,387	10,498	9,279	8,199	7,313	6,527
Lake Grapevine*	1,983	1,950	1,917	1,883	1,850	1,817
Total Current Supplies	***19,084***	***19,535***	***18,053***	***16,606***	***15,469***	***14,503***
Need (Demand - Current Supply)	***504***	***2,095***	***3,793***	***5,156***	***6,276***	***7,241***
Water Management Strategies						
Water Conservation	339	537	622	688	756	825
Additional Water from TRA	0	1,037	2,256	3,336	4,222	5,008
Additional Water from Dallas	165	522	915	1,132	1,298	1,408
Total Water Management Strategies	***504***	***2,095***	***3,793***	***5,156***	***6,276***	***7,241***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**
Alternative Water Management Strategy						
Purchase unused Lake Grapevine yield from DCPCMUD	5,222	5,094	5,067	4,980	4,841	4,692

* Lake Grapevine supply is based on Grapevine's portion of the firm yield as calculated by TCEQ WAM. It is significantly less then Grapevine's water right amount.

Haltom City

Haltom City has a population of about 42,700 and is located in central Tarrant County. The city purchases treated water from Fort Worth, which gets raw water from TRWD. Haltom City's water management strategies are conservation and additional water from Fort Worth. Table 5D.330 shows the projected population and demand, the current supplies, and the water management strategies for Haltom City.

Table 5D.330
Projected Population and Demand, Current Supplies, and Water Management Strategies for Haltom City

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (In City Only)	**44,000**	**45,000**	**47,000**	**51,000**	**55,000**	**60,000**
Projected Water Demand						
Municipal Demand	5,285	5,226	5,308	5,670	6,093	6,640
Total Projected Demand	***5,285***	***5,226***	***5,308***	***5,670***	***6,093***	***6,640***
Currently Available Water Supplies						
Fort Worth (TRWD)	5,241	4,215	3,628	3,490	3,432	3,439
Total Current Supplies	***5,241***	***4,215***	***3,628***	***3,490***	***3,432***	***3,439***
Need (Demand - Current Supply)	***44***	***1,011***	***1,680***	***2,180***	***2,661***	***3,201***
Water Management Strategies						
Water Conservation	44	61	53	76	102	133
Additional Water from Fort Worth	0	950	1,627	2,104	2,559	3,068
Total Water Management Strategies	***44***	***1,011***	***1,680***	***2,180***	***2,661***	***3,201***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Haslet

Haslet is a city of about 1,600 people located in northern Tarrant County. The city's water supply is treated water from Fort Worth (which gets its raw water from TRWD) and groundwater from the Trinity aquifer. Water management strategies for Haslet are conservation and additional water from Fort Worth (which does not require additional infrastructure). Table 5D.331 shows the projected population and demand, the current supplies, and the water management strategies for Haslet.

Table 5D.331
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Haslet

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population (In City Only)	**1,630**	**2,000**	**2,303**	**5,000**	**7,000**	**8,000**
Projected Water Demand						
Municipal Demand	532	644	736	1,589	2,222	2,539
Total Projected Demand	***532***	***644***	***736***	***1,589***	***2,222***	***2,539***
Currently Available Water Supplies						
Fort Worth (TRWD)	465	469	460	939	1,216	1,282
Trinity Aquifer	63	63	63	63	63	63
Total Current Supplies	***528***	***532***	***523***	***1,002***	***1,279***	***1,345***
Need (Demand - Current Supply)	***4***	***112***	***213***	***587***	***943***	***1,194***
Water Management Strategies						
Water Conservation	4	17	26	72	109	133
Additional Water from Fort Worth	0	95	187	515	834	1,061
Total Water Management Strategies	***4***	***112***	***213***	***587***	***943***	***1,194***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Hurst

Hurst has a population of about 38,000 and is located in northeast Tarrant County. The city gets its water supply from Fort Worth (which gets raw water from TRWD) and groundwater from the Trinity aquifer. Hurst's water management strategies are conservation and additional water from Fort Worth. Table 5D.332 shows the projected population and demand, the current supplies, and the water management strategies for Hurst.

Table 5D.332
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Hurst

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**40,000**	**41,000**	**41,000**	**41,000**	**41,000**	**41,000**
Projected Water Demand						
Municipal Demand	6,828	6,819	6,680	6,604	6,590	6,590

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Projected Demand	***6,828***	***6,819***	***6,680***	***6,604***	***6,590***	***6,590***
Currently Available Water Supplies						
Trinity Aquifer	816	816	816	816	816	816
Fort Worth (TRWD)	5,793	4,841	4,008	3,563	3,253	2,990
Total Current Supplies	***6,609***	***5,657***	***4,824***	***4,379***	***4,069***	***3,806***
Need (Demand - Current Supply)	***219***	***1,162***	***1,856***	***2,225***	***2,521***	***2,784***
Water Management Strategies						
Water Conservation	219	275	292	311	332	354
Additional Water from Fort Worth	0	887	1,564	1,914	2,189	2,430
Total Water Management Strategies	***219***	***1,162***	***1,856***	***2,225***	***2,521***	***2,784***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Johnson County Special Utility District

The Johnson County Special Utility District has a large service area in Johnson and Hill Counties in the Brazos G region and Tarrant and Ellis Counties in Region C. The majority of the population served by the SUD is in Johnson County, and the Brazos G Regional Water Plan deals with the SUD's overall water supply strategies. Johnson County SUD's water supply plans for Region C are discussed under Ellis County in Section 5D.5.

Keller

Keller is a city of about 42,000 people located in northern Tarrant County. The city's water supply is treated water from Fort Worth (which gets its raw water from TRWD). Water management strategies for Keller are conservation and additional water from Fort Worth, with an increase in delivery infrastructure (pump station expansion and pipeline). Table 5D.333 shows the projected population and demand, the current supplies, and the water management strategies for Keller.

Table 5D.333
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Keller

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**47,663**	**51,310**	**51,310**	**51,310**	**51,310**	**51,310**
Projected Water Demand						
Municipal Demand	12,182	12,981	12,906	12,862	12,847	12,846

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Projected Demand	***12,182***	***12,981***	***12,906***	***12,862***	***12,847***	***12,846***
Currently Available Water Supplies						
Fort Worth (TRWD)	11,959	10,469	8,822	7,917	7,237	6,653
Total Current Supplies	***11,959***	***10,469***	***8,822***	***7,917***	***7,237***	***6,653***
Need (Demand - Current Supply)	***223***	***2,512***	***4,084***	***4,945***	***5,610***	***6,193***
Water Management Strategies						
Water Conservation	223	342	387	429	471	514
Add'l Water from Fort Worth; Expand PS & Pipeline	0	2,170	3,697	4,516	5,139	5,679
Total Water Management Strategies	***223***	***2,512***	***4,084***	***4,945***	***5,610***	***6,193***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Kennedale

Kennedale is located in southern Tarrant County, has a population of about 7,000, and provides retail water supply to some Tarrant County Manufacturing. The city's water supply is from groundwater (Trinity aquifer) and treated water from Fort Worth (which gets its raw water from TRWD). Water management strategies for Kennedale include conservation and additional water from Fort Worth (including an increase in delivery infrastructure), and connecting to and purchasing water from Arlington. Table 5D.334 shows the projected population and demand, the current supplies, and the water management strategies for Kennedale.

Table 5D.334
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Kennedale

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**8,000**	**9,200**	**10,824**	**11,303**	**11,626**	**11,626**
Projected Water Demand						
Municipal Demand	1,413	1,588	1,840	1,909	1,961	1,961
Tarrant County Manufacturing	102	118	135	150	162	176
Total Projected Demand	***1,515***	***1,706***	***1,975***	***2,059***	***2,123***	***2,137***
Currently Available Water Supplies						
Trinity Aquifer	1,221	1,221	1,221	1,221	1,221	1,221
Fort Worth (TRWD)	356	438	543	532	516	474
Total Current Supplies	***1,577***	***1,659***	***1,764***	***1,753***	***1,737***	***1,695***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Need (Demand - Current Supply)	***0***	***47***	***211***	***306***	***386***	***442***
Water Management Strategies						
Water Conservation	12	34	46	64	72	78
Additional Water from Fort Worth	0	71	206	268	328	364
Increase delivery infrastructure from Ft Worth	*0*	*0*	*188*	*239*	*283*	*277*
Water from Arlington (TRWD); initial connection	280	280	280	280	280	280
Total Water Management Strategies	***292***	***385***	***532***	***612***	***680***	***722***
Reserve (Shortage)	**354**	**338**	**321**	**306**	**294**	**280**

Lake Worth

Lake Worth has a population of about 4,800 and is located in western Tarrant County. The city gets its water supply from Fort Worth (which gets raw water from TRWD) and groundwater from the Trinity aquifer. Lake Worth's water management strategies are conservation and additional water from Fort Worth. Table 5D.335 shows the projected population and demand, the current supplies, and the water management strategies for Lake Worth.

Table 5D.335
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Lake Worth

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**5,186**	**5,831**	**6,468**	**7,500**	**8,800**	**12,000**
Projected Water Demand						
Municipal Demand	1,137	1,248	1,363	1,567	1,836	2,501
Total Projected Demand	***1,137***	***1,248***	***1,363***	***1,567***	***1,836***	***2,501***
Currently Available Water Supplies						
Trinity Aquifer	345	345	345	345	345	345
Fort Worth (TRWD)	771	728	696	752	840	1,117
Total Current Supplies	***1,116***	***1,073***	***1,041***	***1,097***	***1,185***	***1,462***
Need (Demand - Current Supply)	***21***	***175***	***322***	***470***	***651***	***1,039***
Water Management Strategies						
Water Conservation	21	33	41	52	67	100

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from Fort Worth	0	142	281	418	584	939
Total Water Management Strategies	***21***	***175***	***322***	***470***	***651***	***1,039***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Lakeside

Lakeside is a city of about 1,300 people located in western Tarrant County. The city's water supply is groundwater from the Trinity aquifer. The groundwater is sufficient to meet demand, and the only water management strategy for Lakeside is conservation. Table 5D.336 shows the projected population and demand, the current supplies, and the water management strategies for Lakeside.

Table 5D.336
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Lakeside

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,350**	**1,400**	**1,450**	**1,500**	**1,500**	**1,500**
Projected Water Demand						
Municipal Demand	227	230	234	239	239	239
Total Projected Demand	***227***	***230***	***234***	***239***	***239***	***239***
Currently Available Water Supplies						
Trinity Aquifer	262	262	262	262	262	262
Total Current Supplies	***262***	***262***	***262***	***262***	***262***	***262***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	2	3	2	3	4	5
Total Water Management Strategies	***2***	***3***	***2***	***3***	***4***	***5***
Reserve (Shortage)	**37**	**35**	**30**	**26**	**27**	**28**

Mansfield

The City of Mansfield has a population of about 59,400 people in Ellis, Johnson and Tarrant Counties. Mansfield is a wholesale water provider, and there is a discussion of the city's water supply plans in Section 5C.2.

North Richland Hills

North Richland Hills is located in northern Tarrant County and has a population of about 65,700. North Richland Hills is a wholesale water provider, and there is a discussion of the city's water supply plans in Section 5C.2.

Pantego

Pantego is a city of about 2,500 people located in eastern Tarrant County. The city's water supply is groundwater from the Trinity aquifer. Water management strategies for Pantego are conservation and connecting to and purchasing treated water from Fort Worth and Arlington (both of which get raw water from TRWD). Table 5D.337 shows the projected population and demand, the current supplies, and the water management strategies for Pantego.

Table 5D.337
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Pantego

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**2,400**	**2,400**	**2,400**	**2,400**	**2,400**	**2,400**
Projected Water Demand						
Municipal Demand	621	610	601	596	595	595
Total Projected Demand	***621***	***610***	***601***	***596***	***595***	***595***
Currently Available Water Supplies						
Trinity Aquifer	732	732	732	732	732	732
Total Current Supplies	***732***	***732***	***732***	***732***	***732***	***732***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	5	7	6	8	10	12
Fort Worth (TRWD)	0	27	27	26	25	24
Arlington (TRWD)	0	27	27	26	25	24
Total Water Management Strategies	***5***	***61***	***60***	***60***	***60***	***60***
Reserve (Shortage)	**116**	**183**	**191**	**196**	**197**	**197**

Pelican Bay

Pelican Bay is located in northwestern Tarrant County and has a population of about 1,600. The city's water supply is groundwater from the Trinity aquifer. Water management strategies for Pelican Bay include conservation and connecting to and purchasing water from Azle (which gets its raw water from

TRWD). Table 5D.338 shows the projected population and demand, the current supplies, and the water management strategies for Pelican Bay.

Table 5D.338
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Pelican Bay

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**1,575**	**1,605**	**1,635**	**1,664**	**1,693**	**1,721**
Projected Water Demand						
Municipal Demand	106	108	110	112	114	116
Total Projected Demand	***106***	***108***	***110***	***112***	***114***	***116***
Currently Available Water Supplies						
Trinity Aquifer	117	117	117	117	117	117
Total Current Supplies	***117***	***117***	***117***	***117***	***117***	***117***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	1	1	1	1	2	2
Azle (TRWD) initial connection	0	11	11	11	11	12
Total Water Management Strategies	***1***	***12***	***12***	***12***	***13***	***14***
Reserve (Shortage)	**12**	**21**	**19**	**17**	**16**	**15**

Reno

Reno has a population of about 2,500 and is located in northeastern Parker and northwest Tarrant County. The water supply plans for Reno are discussed under Parker County in Section 5D.12.

Richland Hills

Richland Hills has a population of about 7,900 and is located in central Tarrant County. The city gets its water supply from Fort Worth (which gets raw water from TRWD) and groundwater from the Trinity aquifer. Richland Hills' water management strategies are conservation and additional water from Fort Worth. Table 5D.339 shows the projected population and demand, the current supplies, and the water management strategies for Richland Hills.

Table 5D.339
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Richland Hills

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**8,401**	**9,001**	**9,601**	**10,850**	**12,000**	**13,500**
Projected Water Demand						
Municipal Demand	1,148	1,185	1,228	1,372	1,513	1,700
Total Projected Demand	***1,148***	***1,185***	***1,228***	***1,372***	***1,513***	***1,700***
Currently Available Water Supplies						
Trinity Aquifer	242	242	242	242	242	242
Fort Worth (TRWD)	896	761	674	696	716	755
Total Current Supplies	***1,138***	***1,003***	***916***	***938***	***958***	***997***
Need (Demand - Current Supply)	***10***	***182***	***312***	***434***	***555***	***703***
Water Management Strategies						
Water Conservation	10	14	12	18	25	34
Additional Water from Fort Worth	0	168	300	416	530	669
Total Water Management Strategies	***10***	***182***	***312***	***434***	***555***	***703***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

River Oaks

River Oaks is a city of about 7,300 people located in western Tarrant County. The city operates its own water treatment plant and gets raw water from TRWD. Water management strategies for River Oaks are conservation and purchasing additional water from TRWD. Table 5D.340 shows the projected population and demand, the current supplies, and the water management strategies for River Oaks.

Table 5D.340
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of River Oaks

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**7,500**	**7,500**	**7,500**	**7,500**	**7,500**	**7,500**
Projected Water Demand						
Municipal Demand	850	817	790	775	772	772
Total Projected Demand	***850***	***817***	***790***	***775***	***772***	***772***
Currently Available Water Supplies						
TRWD	850	744	635	551	489	437

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***850***	***744***	***635***	***551***	***489***	***437***
Need (Demand - Current Supply)	***0***	***73***	***155***	***224***	***283***	***335***
Water Management Strategies						
Water Conservation	7	10	8	10	13	15
Additional Water from TRWD	0	63	147	214	270	320
Total Water Management Strategies	***7***	***73***	***155***	***224***	***283***	***335***
Reserve (Shortage)	**7**	**0**	**0**	**0**	**0**	**0**

Saginaw

Saginaw is located in northern Tarrant County and has a population of about 20,000. The city's water supply is treated water from Fort Worth, which gets raw water from TRWD. Water management strategies for Saginaw include conservation and additional treated water from Fort Worth (which does not require additional infrastructure). Table 5D.341 shows the projected population and demand, the current supplies, and the water management strategies for Saginaw.

Table 5D.341
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Saginaw

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**23,004**	**26,202**	**29,400**	**31,000**	**31,000**	**31,000**
Projected Water Demand						
Municipal Demand	3,148	3,503	3,876	4,059	4,052	4,051
Total Projected Demand	***3,148***	***3,503***	***3,876***	***4,059***	***4,052***	***4,051***
Currently Available Water Supplies						
Fort Worth (TRWD)	3,122	2,825	2,649	2,498	2,283	2,098
Total Current Supplies	***3,122***	***2,825***	***2,649***	***2,498***	***2,283***	***2,098***
Need (Demand - Current Supply)	***26***	***678***	***1,227***	***1,561***	***1,769***	***1,953***
Water Management Strategies						
Water Conservation	26	39	39	54	68	81
Additional Water from Fort Worth	0	639	1,188	1,507	1,701	1,872
Total Water Management Strategies	***26***	***678***	***1,227***	***1,561***	***1,769***	***1,953***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Sansom Park Village

Sansom Park Village has a population of about 4,700 and is located in western Tarrant County. The city gets its water supply from groundwater from the Trinity aquifer and treated water from Fort Worth (which gets raw water from TRWD). Sansom Park Village's water management strategies are conservation and additional water from Fort Worth. Table 5D.342 shows the projected population and demand, the current supplies, and the water management strategies for Sansom Park Village.

Table 5D.342
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Sansom Park Village

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**4,800**	**5,100**	**5,723**	**6,064**	**6,406**	**6,740**
Projected Water Demand						
Municipal Demand	534	545	592	617	650	683
Total Projected Demand	***534***	***545***	***592***	***617***	***650***	***683***
Currently Available Water Supplies						
Trinity Aquifer	578	578	578	578	578	578
Fort Worth (TRWD)	0	0	10	24	41	54
Total Current Supplies	***578***	***578***	***588***	***602***	***619***	***632***
Need (Demand - Current Supply)	***0***	***0***	***4***	***15***	***31***	***51***
Water Management Strategies						
Water Conservation	4	6	6	8	11	14
Additional Fort Worth (TRWD)	0	0	0	7	20	37
Total Water Management Strategies	***4***	***6***	***6***	***15***	***31***	***51***
Reserve (Shortage)	**48**	**39**	**2**	**0**	**0**	**0**

Southlake

Southlake is a city of about 27,000 in northwestern Tarrant County, with some area in southern Denton County. The city's water supply is treated water from Fort Worth, which gets raw water from TRWD. Water management strategies for Southlake include conservation and additional treated water from Fort Worth, which requires increasing delivery infrastructure from Fort Worth. Table 5D.343 shows the projected population and demand, the current supplies, and the water management strategies for Southlake.

Table 5D.343
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Southlake

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**27,818**	**31,315**	**36,669**	**42,065**	**47,528**	**53,057**
Projected Water Demand						
Municipal Demand	11,501	12,865	15,005	17,178	19,392	21,642
Total Projected Demand	***11,501***	***12,865***	***15,005***	***17,178***	***19,392***	***21,642***
Currently Available Water Supplies						
Fort Worth (TRWD)	11,240	10,376	10,256	10,574	10,924	11,208
Total Current Supplies	***11,240***	***10,376***	***10,256***	***10,574***	***10,924***	***11,208***
Need (Demand - Current Supply)	***261***	***2,489***	***4,749***	***6,604***	***8,468***	***10,434***
Water Management Strategies						
Water Conservation	261	393	517	649	797	962
Additional Fort Worth (TRWD)	0	2,096	4,232	5,955	7,671	9,472
Increase delivery infrastructure from Ft Worth	*0*	*141*	*2,157*	*4,198*	*6,264*	*8,349*
Total Water Management Strategies	***261***	***2,489***	***4,749***	***6,604***	***8,468***	***10,434***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Tarrant County Irrigation

Table 5D.344 shows the projected demand, the current supplies, and the water management strategies for Tarrant County Irrigation. The vast majority of irrigation use in Tarrant County is for golf course irrigation. (The Texas Water Development Board classifies the use of potable water for golf course irrigation as a part of municipal use. The use of raw water or reuse of treated wastewater effluent for golf course irrigation is classified as irrigation use.) The current supplies are local surface water supplies, direct reuse from Azle and Fort Worth, indirect reuse, raw water from TRWD, and groundwater from the Trinity and Woodbine aquifers. Water management strategies for Tarrant County Irrigation include conservation, and additional water from TRWD.

Table 5D.344
Projected Demand, Current Supplies,
and Water Management Strategies for Tarrant County Irrigation

(Values in Ac-Ft/Yr)	**Projected Demand**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**4,466**	**4,466**	**4,466**	**4,466**	**4,466**	**4,466**
Currently Available Water Supplies						
Local Supplies	549	549	549	549	549	549
Trinity Aquifer	752	752	752	752	752	752
Woodbine Aquifer	632	632	632	632	632	632
Indirect Reuse (DCPCMUD through Grapevine)	1,121	1,121	1,121	1,121	1,121	1,121
Direct Reuse (Azle)	300	300	300	300	300	300
Tarrant Regional Water District	1,340	1,219	1,078	952	849	758
Direct Reuse (Fort Worth)	2,000	2,000	2,000	2,000	2,000	2,000
Total Current Supplies	***6,694***	***6,574***	***6,432***	***6,307***	***6,204***	***6,112***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation	8	138	266	334	396	459
Additional Water from TRWD	0	0	0	53	94	123
Total Water Management Strategies	***8***	***138***	***266***	***387***	***490***	***582***
Reserve (Shortage)	**2,236**	**2,246**	**2,232**	**2,228**	**2,228**	**2,228**

Tarrant County Livestock

Table 5D.345 shows the projected demand, current supplies, and water management strategies for Tarrant County Livestock. The current supplies are local surface water supplies and groundwater from the Trinity aquifer. These sources are sufficient to meet projected demands, and there are no water management strategies for this water user group.

Table 5D.345
Projected Demand, Current Supplies,
and Water Management Strategies for Tarrant County Livestock

(Values in Ac-Ft/Yr)	**Projected Demand**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**723**	**723**	**723**	**723**	**723**	**723**
Currently Available Water Supplies						
Trinity Aquifer	281	281	281	281	281	281
Local Supplies	442	442	442	442	442	442

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Total Current Supplies	***723***	***723***	***723***	***723***	***723***	***723***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Tarrant County Manufacturing

Table 5D.346 shows the projected demand and current supplies for Tarrant County Manufacturing. Current supplies are water from the TRWD through numerous water suppliers in the county, and groundwater from the Trinity Aquifer. The water management strategies for this water user group are conservation and additional water from TRWD (through various water suppliers).

Table 5D.346
Projected Demand, Current Supplies,
and Water Management Strategies for Tarrant County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**20,444**	**23,630**	**26,924**	**29,919**	**32,457**	**35,210**
Currently Available Water Supplies						
Trinity Aquifer	1,937	1,937	1,937	1,937	1,937	1,937
Trinity Aquifer (Through Kennedale)	102	118	135	150	162	176
Fort Worth (TRWD Sources)	16,049	14,961	14,446	14,456	14,353	14,314
Arlington (TRWD Sources)	2,275	2,418	2,455	2,424	2,356	2,289
Mansfield (TRWD Sources)	279	296	300	280	274	269
Grand Prairie (TRWD Sources)	197	180	162	157	148	147
Total Current Supplies	***20,839***	***19,910***	***19,435***	***19,404***	***19,230***	***19,132***
Need (Demand - Current Supply)	***0***	***3,720***	***7,489***	***10,515***	***13,227***	***16,078***
Water Management Strategies						
Water Conservation	0	47	556	834	919	999
Add'l water from Ft Worth (TRWD)	0	3,552	6,253	8,375	10,405	12,542
Add'l water from Arlington (TRWD)	178	412	709	1,066	1,429	1,816
Add'l water from Mansfield (TRWD)	130	176	226	302	356	415
Add'l water from Grand Prairie (TRWD)	110	173	234	279	325	366

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Total Water Management Strategies	***418***	***4,361***	***7,978***	***10,856***	***13,434***	***16,138***
Reserve (Shortage)	**813**	**641**	**489**	**341**	**207**	**60**

Tarrant County Mining

Table 5D.347 shows the projected demand, the current supplies, and the water management strategies for Tarrant County Mining. Tarrant County Mining is supplied from local supplies, raw water from TRWD (through numerous water suppliers), and the Trinity aquifer. The only water management strategy for this water user group is additional water from TRWD. Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG.

Table 5D.347
Projected Demand, Current Supplies,
and Water Management Strategies for Tarrant County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**7,367**	**4,482**	**1,589**	**1,537**	**1,497**	**1,464**
Currently Available Water Supplies						
Local supplies	342	342	342	342	342	342
Tarrant Regional Water District	6,567	3,351	635	524	442	376
Trinity Aquifer	800	800	800	800	800	800
Total Current Supplies	***7,709***	***4,493***	***1,777***	***1,666***	***1,584***	***1,518***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Additional TRWD	0	331	154	213	255	288
Total Water Management Strategies	***0***	***331***	***154***	***213***	***255***	***288***
Reserve (Shortage)	**342**	**342**	**342**	**342**	**342**	**342**

Tarrant County Other

Tarrant County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups and also include the Dallas-Fort Worth International Airport. The entities included under Tarrant County Other supply about 35,000 people, and this population is projected to increase. The Tarrant County Other supply comes from the TRWD (through various water suppliers), reuse, DWU, and groundwater (Trinity aquifer). The cities of Dallas and Fort Worth both serve the Dallas-Fort Worth International Airport. Water management strategies for these entities include conservation, and additional water from TRWD, additional water from Fort Worth, and additional water from Dallas. An alternative future strategy would be to get water from the City of Euless in place of a portion of the supply from Fort Worth. Table 5D.348 shows the projected population and demand, the current supplies, and the water management strategies for Tarrant County Other.

Table 5D.348
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Tarrant County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**36,012**	**36,012**	**36,012**	**60,000**	**80,000**	**110,000**
Projected Water Demand						
Municipal Demand	8,008	7,862	7,743	11,410	14,509	19,178
Total Projected Water Demand	***8,008***	***7,862***	***7,743***	***11,410***	***14,509***	***19,178***
Currently Available Water Supplies						
Trinity Aquifer	1,200	1,200	1,200	1,200	1,200	1,200
Tarrant Regional Water District direct	240	212	183	292	358	452
Fort Worth	4,574	3,570	2,949	4,800	6,051	7,860
Fort Worth for DFW Airport	724	614	581	524	479	440
Fort Worth Reuse for DFW Airport	40	40	150	150	150	150
Dallas Water Utilities (for DFW Aiport)	1,145	1,041	775	715	668	637
Total Current Supplies	***7,924***	***6,677***	***5,838***	***7,681***	***8,907***	***10,739***
Need (Demand - Current Supply)	***84***	***1,185***	***1,905***	***3,729***	***5,602***	***8,439***
Water Management Strategies						
Water Conservation	50	69	57	125	208	344
Additional Water from TRWD direct	0	19	42	115	199	333
Additional Water from Fort Worth	0	818	1,333	2,913	4,537	7,045
Add'l Water from Ft Worth (for DFW Airport)	77	187	420	477	522	561
Add'l Dallas (for DFW Airport)	56	160	226	286	333	364
Total Water Management Strategies	***183***	***1,253***	***2,078***	***3,915***	***5,799***	***8,647***
Reserve (Shortage)	**99**	**68**	**173**	**186**	**196**	**208**
Alternative Water Management Strategies						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Water from Euless (TRA/TRWD) to DFW Airport (in lieu of portion of Ft Worth supply)	0	1,000	1,000	2,000	2,000	2,000

Tarrant County Steam Electric Power

Table 5D.349 shows the projected demand, the current supplies, and the water management strategies for Tarrant County Steam Electric Power. Tarrant County Steam Electric Power is supplied from run-of-the-river supplies and raw water from TRWD. Water management strategies for Tarrant County Steam Electric Power are additional water from TRWD and reuse. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.349
Projected Demand, Current Supplies,
and Water Management Strategies for Tarrant County Steam Electric Power

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**2,448**	**4,168**	**5,000**	**5,000**	**5,000**	**5,000**
Currently Available Water Supplies						
Run-of-River supplies	959	959	959	959	959	959
Tarrant Regional Water District	2,448	2,228	1,969	1,740	1,552	1,385
Total Current Supplies	***3,407***	***3,187***	***2,928***	***2,699***	***2,511***	***2,344***
Need (Demand - Current Supply)	***0***	***981***	***2,072***	***2,301***	***2,489***	***2,656***
Water Management Strategies						
Additional Water from TRWD	0	220	479	708	896	1,063
Reuse	0	1,528	2,360	2,360	2,360	2,360
Total Water Management Strategies	***0***	***1,748***	***2,839***	***3,068***	***3,256***	***3,423***
Reserve (Shortage)	**959**	**767**	**767**	**767**	**767**	**767**

Trophy Club

Trophy Club has a population of about 10,100 in southern Denton County and Northern Tarrant County. Trophy Club MUD #1 provides retail service to the city of Trophy Club. Water management strategies for Trophy Club are discussed on under Denton County in Section 5D.4.

Watauga

Watauga is a city of about 23,500 in northern Tarrant County. The city's water supply is treated water from North Richland Hills (which in turn buys treated water from Fort Worth, which gets raw water from TRWD). Water management strategies for Watauga include conservation and additional treated water from North Richland Hills. Table 5D.350 shows the projected population and demand, the current supplies, and the water management strategies for Watauga.

Table 5D.350
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Watauga

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**25,000**	**25,000**	**25,000**	**25,000**	**25,000**	**25,000**
Projected Water Demand						
Municipal Demand	2,899	2,794	2,707	2,659	2,650	2,650
Total Projected Demand	***2,899***	***2,794***	***2,707***	***2,659***	***2,650***	***2,650***
Currently Available Water Supplies						
North Richland Hills (from Fort Worth from TRWD)	1,895	1,642	1,426	1,416	1,414	1,372
Total Current Supplies	***1,895***	***1,642***	***1,426***	***1,416***	***1,414***	***1,372***
Need (Demand - Current Supply)	***1,004***	***1,152***	***1,281***	***1,243***	***1,236***	***1,278***
Water Management Strategies						
Water Conservation	24	33	27	35	44	53
Additional Water from North Richland Hills	980	1,119	1,254	1,208	1,192	1,225
Increase in delivery infrastructure from Fort Worth (jointly with North Richland Hills)	*See North Richland Hills*					
Total Water Management Strategies	***1,004***	***1,152***	***1,281***	***1,243***	***1,236***	***1,278***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Westlake

Westlake is a city of about 1,000 in northern Tarrant County and southern Denton County. The city's water supply is treated water from Fort Worth (which gets raw water from TRWD). Water management strategies for Westlake include conservation and additional treated water from Fort Worth, with an increase in delivery infrastructure from Fort Worth (joint project with Fort Worth and Trophy Club). Table

5D.351 shows the projected population and demand, the current supplies, and the water management strategies for Westlake.

Table 5D.351
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Westlake

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,200**	**1,800**	**2,609**	**3,144**	**3,682**	**4,211**
Projected Water Demand						
Municipal Demand	1,388	2,078	3,007	3,623	4,242	4,850
Total Projected Demand	***1,388***	***2,078***	***3,007***	***3,623***	***4,242***	***4,850***
Currently Available Water Supplies						
Fort Worth (from TRWD)	1,363	1,676	2,055	2,230	2,390	2,512
Total Current Supplies	***1,363***	***1,676***	***2,055***	***2,230***	***2,390***	***2,512***
Need (Demand - Current Supply)	***25***	***402***	***952***	***1,393***	***1,852***	***2,338***
Water Management Strategies						
Water Conservation	25	52	90	121	156	194
Additional Water from Fort Worth	0	350	862	1,272	1,696	2,144
Increase delivery infrastructure from Ft Worth; joint project with Ft Worth, Westlake, Trophy Club	*42*	*705*	*1,596*	*2,181*	*2,765*	*3,335*
Total Water Management Strategies	***25***	***402***	***952***	***1,393***	***1,852***	***2,338***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Westover Hills

Westover Hills has a population of about 700 and is located in western Tarrant County. The city purchases treated water from Fort Worth (which gets raw water from TRWD). Westover Hills' water management strategies are conservation and additional water from Fort Worth. Table 5D.352 shows the projected population and demand, the current supplies, and the water management strategies for Westover Hills.

Table 5D.352
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Westover Hills

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**698**	**715**	**732**	**749**	**766**	**782**
Projected Water Demand						

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Municipal Demand	952	972	992	1,013	1,036	1,058
Total Projected Demand	***952***	***972***	***992***	***1,013***	***1,036***	***1,058***
Currently Available Water Supplies						
Fort Worth (TRWD)	913	784	678	624	584	548
Total Current Supplies	***913***	***784***	***678***	***624***	***584***	***548***
Need (Demand - Current Supply)	***39***	***188***	***314***	***389***	***452***	***510***
Water Management Strategies						
Water Conservation	39	85	90	95	101	107
Additional Water from Fort Worth	0	103	224	294	351	403
Total Water Management Strategies	***39***	***188***	***314***	***389***	***452***	***510***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Westworth Village

Westworth Village is located in western Tarrant County and has a population of about 2,500. The city's water supply is treated water from Fort Worth, which gets raw water from TRWD. Water management strategies for Westworth Village include conservation and additional treated water from Fort Worth. Table 5D.353 shows the projected population and demand, the current supplies, and the water management strategies for Westworth Village.

Table 5D.353
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Westworth Village

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,700**	**2,945**	**3,187**	**3,422**	**3,658**	**3,889**
Projected Water Demand						
Municipal Demand	395	417	441	468	499	530
Total Projected Demand	***395***	***417***	***441***	***468***	***499***	***530***
Currently Available Water Supplies						
Fort Worth (TRWD)	392	336	301	288	281	274
Total Current Supplies	***392***	***336***	***301***	***288***	***281***	***274***
Need (Demand - Current Supply)	***3***	***81***	***140***	***180***	***218***	***256***
Water Management Strategies						
Water Conservation	3	5	4	6	8	11

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Water from Fort Worth	0	76	136	174	210	245
Total Water Management Strategies	***3***	***81***	***140***	***180***	***218***	***256***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

White Settlement

White Settlement is a city of about 16,700 in western Tarrant County. The city's water supply is treated water from Fort Worth (which gets raw water from TRWD) and groundwater from the Trinity aquifer. Water management strategies for White Settlement include conservation and additional treated water from Fort Worth. Table 5D.354 shows the projected population and demand, the current supplies, and the water management strategies for White Settlement.

Table 5D.354
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of White Settlement

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**16,957**	**17,858**	**18,750**	**22,000**	**28,000**	**34,000**
Projected Water Demand						
Municipal Demand	2,081	2,108	2,146	2,472	3,132	3,798
Total Projected Demand	***2,081***	***2,108***	***2,146***	***2,472***	***3,132***	***3,798***
Currently Available Water Supplies						
Trinity Aquifer	1,040	1,040	1,040	1,040	1,040	1,040
Fort Worth (TRWD)	1,024	861	756	881	1,178	1,428
Total Current Supplies	***2,064***	***1,901***	***1,796***	***1,921***	***2,218***	***2,468***
Need (Demand - Current Supply)	***17***	***207***	***350***	***551***	***914***	***1,330***
Water Management Strategies						
Water Conservation	17	24	21	33	52	76
Additional Water from Fort Worth	0	183	329	518	862	1,254
Total Water Management Strategies	***17***	***207***	***350***	***551***	***914***	***1,330***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Costs for Tarrant County Water User Groups

Table 5D.355 shows the estimated capital costs for Tarrant County recommended water management strategies not covered under the wholesale water providers. Table 5D.356 summarizes the costs by category. Table 5D.357 shows the estimated capital costs for Tarrant County alternative water management strategies not covered under the wholesale water providers, and is followed by a summary for Tarrant County.

Table 5D.355
Costs for Recommended Water Management Strategies for Tarrant County
Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Arlington	Conservation	2020	2,806	$3,066,441	$1.73	$0.48	Q-10
	Other Measures	See Arlington in Section 5C.2.					
Azle*	Conservation	2020	68	$217,081	$3.72	$0.00	Q-10
	Additional TRWD	2020	1,641	$0	$0.97	$0.97	None
	Water treatment plant expansion	*2020*	*1,641*	$11,046,000	$2.47	$0.74	Q-13
Bedford	Conservation	2020	428	$91,493,519	$22.97	$0.79	Q-10 & Q-208
	Additional TRA (TRWD)	2040	3,900	$0	$2.90	$2.90	None
Benbrook	Conservation	2020	512	$218,669	$2.51	$0.79	Q-10
	Additional TRWD	2020	5,683	$0	$0.97	$0.97	None
	Water treatment plant expansions	*2020*	*2,342*	$13,715,000	$2.15	$0.64	Q-13
Bethesda WSC*	Conservation	2020	117	$139,100	$3.21	$1.00	Q-10
	Additional Fort Worth	2020	3,496	$0	$1.96	$1.96	None
	Supply from Arlington	2020	2,614	$0	$2.50	$2.50	None
	Connection to Arlington	*2020*	*2,614*	$18,698,000	$2.16	$0.32	Q-184
Blue Mound	Conservation	2020	3	$4,100	$0.53	$0.00	Q-10
	Purchase Existing Water System from Monarch Utilities	2020	0	$5,000,000	N/A	N/A	Q-185

Burleson*	Conservation	2020	55	$37,638	$0.88	$0.00	Q-10
	Additional Fort Worth (TRWD)	2020	10,244	$0	$1.96	$1.96	None
	Increase delivery infrastructure from Fort Worth	*2040*	*5,541*	$21,780,000	$1.23	$0.22	Q-186
Colleyville	Conservation	2020	426	$421,926	$1.71	$0.48	Q-10
	Additional TRA (TRWD)	2030	4,197	$0	$2.90	$2.90	None
Community WSC	Conservation	2020	10	$8,353	$0.72	$0.00	Q-10
	Additional TRWD	2020	208	$0	$0.97	$0.97	None
Crowley	Conservation	2020	113	$342,055	$4.39	$0.00	Q-10
	Additional Fort Worth (TRWD)	2020	3,588	$0	$1.96	$1.96	None
	Increase delivery infrastructure from Fort Worth	*2030*	*3,028*	$11,558,000	$1.21	$0.23	Q-187
Dalworthington Gardens	Conservation	2020	39	$35,744	$1.72	$0.57	Q-10
	Additional Fort Worth (TRWD)	2020	279	$0	$1.96	$1.96	None
Edgecliff Village	Conservation	2020	19	$69,007	$4.78	$1.33	Q-10
	Additional Fort Worth (TRWD)	2020	210	$0	$1.96	$1.96	None
Euless	Conservation	2020	178	$1,299,359	$4.01	$0.00	Q-10
	Additional TRA (TRWD)	2020	3,006	$0	$2.90	$2.90	None
Everman	Conservation	2020	10	$62,329	$3.20	$0.00	Q-10
Flower Mound	Conservation	See Denton County.					
	Additional DWU supplies	See Denton County.					
	Additional UTRWD supplies	See Denton County.					
Forest Hill	Conservation	2020	56	$159,491	$3.72	$0.00	Q-10
	Additional Fort Worth (TRWD)	2020	1,302	$0	$1.96	$1.96	None
Fort Worth*	Conservation	2020	19,409	$238,000,000	$2.76	$0.41	Q-10, Q-209 & Q-212
	Other Measures	See Fort Worth in Section 5C.2.					
Grand Prairie*	Conservation	See Dallas County.					
	Other Measures	See Grand Prairie in Section 5C.2.					

Grapevine	Conservation	2020	825	$3,237,778	$3.38	$0.41	Q-10
Grapevine	Additional TRA (TRWD)	2030	5,008	$0	$2.90	$2.90	None
Grapevine	Additional DWU	2020	1,408	$0	$1.48	$1.48	None
Haltom City	Conservation	2020	133	$659,284	$3.85	$0.00	Q-10
Haltom City	Additional Fort Worth (TRWD)	2020	3,068	$0	$1.96	$1.96	None
Haslet	Conservation	2020	133	$27,045	$1.74	$0.58	Q-10
Haslet	Additional Fort Worth (TRWD)	2020	1,061	$0	$1.96	$1.96	None
Hurst	Conservation	2020	354	$936,745	$2.36	$0.79	Q-10
Hurst	Additional Fort Worth (TRWD)	2020	2,430	$0	$1.96	$1.96	None
Johnson County SUD*	Conservation	2020	10	$4,470	$0.57	$0.00	Q-10
Johnson County SUD*	Additional Mansfield (TRWD)	2020	6,229	$0	$2.50	$2.50	None
Johnson County SUD*	Supply from Grand Prairie	2020	6,726	$0	$2.50	$2.50	None
Johnson County SUD*	*Connect to Grand Prairie*	*2020*	*6,726*	$86,140,000	$3.83	$0.54	Q-188
Keller	Conservation	2020	514	$1,810,304	$3.41	$0.60	Q-10
Keller	Additional Fort Worth (TRWD)	2020	5,679	$0	$1.96	$1.96	None
Keller	*Increase delivery infrastructure from Fort Worth*	*2020*	*5,679*	$17,535,000	$0.60	$0.15	Q-189
Kennedale	Conservation	2020	78	$50,144	$1.07	$1.23	Q-10
Kennedale	Additional Fort Worth (TRWD)	2020	364	$0	$1.96	$1.96	None
Kennedale	*Increase delivery infrastructure from Ft Worth*	*2040*	*283*	$3,685,000	$3.94	$0.59	Q-191
Kennedale	Supply from Arlington	2020	280	$0	$2.50	$2.50	None
Kennedale	*Connect to Arlington*	*2020*	*280*	$1,720,000	$1.90	$0.32	Q-190
Lake Worth	Conservation	2020	100	$2,039,240	$27.04	$0.99	Q-10
Lake Worth	Additional Fort Worth (TRWD)	2020	939	$0	$1.96	$1.96	None
Lakeside	Conservation	2020	5	$22,567	$2.90	$0.00	Q-10
Mansfield*	Conservation	2020	1,838	$2,320,683	$2.77	$0.37	Q-10
Mansfield*	Other Measures	See Mansfield in Section 5C.2.					
North Richland Hills	Conservation	2020	521	$1,781,337	$3.57	$0.75	Q-10
North Richland Hills	Other Measures	See North Richland Hills in Section 5C.2.					

Pantego	Conservation	2020	12	$21,919	$1.13	$0.00	Q-10
	Supply from Arlington	2030	27	$0	$2.50	$2.50	None
	Connect to Arlington	*2030*	*27*	$778,000	$8.52	$1.06	Q-192
	Supply from Fort Worth	2030	27	$0	$1.96	$1.96	None
	Connect to Fort Worth	*2030*	*27*	$831,000	$9.21	$1.18	Q-193
Pelican Bay	Conservation	2020	2	$10,113	$2.60	$0.00	Q-10
	Azle (TRWD)	2030	12	$956,000	$22.50	$2.19	Q-194
Reno	Conservation	See Parker County.					
	Additional Walnut Creek SUD	See Parker County.					
Richland Hills	Conservation	2020	34	$143,796	$3.69	$0.00	Q-10
	Additional Fort Worth (TRWD)	2020	669	$0	$1.96	$1.96	None
River Oaks	Conservation	2020	15	$100,337	$3.68	$0.00	Q-10
	Additional TRWD	2020	320	$0	$0.97	$0.97	None
Saginaw	Conservation	2020	81	$1,000,000	$9.88	$0.00	Q-10
	Additional Fort Worth (TRWD)	2020	1,872	$0	$1.96	$1.96	None
Sansom Park	Conservation	2020	14	$14,529	$0.93	$0.00	Q-10
	Additional Fort Worth (TRWD)	2050	37	$0	$1.96	$1.96	None
Southlake*	Conservation	2020	962	$1,698,028	$2.71	$0.46	Q-10
	Additional Fort Worth (TRWD)	2020	9,472	$0	$1.96	$1.96	None
	Increase delivery infrastructure from Ft Worth	*2020*	*8,349*	$43,035,000	$1.47	$0.14	Q-195
Tarrant County Other	Conservation	2020	344	$158,141	$0.81	$0.00	Q-10
	Additional TRWD	2030	333	$0	$0.97	$0.97	None
	Additional Fort Worth (TRWD)	2020	7,606	$0	$1.96	$1.96	None
	Additional Dallas Supplies	2020	364	$0	$1.48	$1.48	None

Trophy Club*	Conservation	See Denton County.					
	Additional Fort Worth	See Denton County.					
	Phase I-Increase delivery infrastructure from Ft Worth; joint project with Ft Worth, Westlake, Trophy Club	See Denton County.					
	Phase II-Increase delivery infrastructure from Ft Worth; 24" line	See Denton County.					
Watauga	Conservation	2020	53	$396,643	$4.24	$0.00	Q-10
	Additional North Richland Hills	2020	1,254	$0	$2.50	$2.50	None
	Increase delivery infrastructure North Richland Hills/Fort Worth	*2020*	*1,254*	$1,874,676	$0.21	$0.03	Q-199
Westlake*	Conservation	2020	194	$40,661	$0.85	$0.19	Q-10
	Additional Fort Worth (TRWD)	2020	2,144	$0	$1.96	$1.96	None
	Increase delivery infrastructure from Ft Worth; joint project with Ft Worth, Westlake, Trophy Club	*2020*	*3,335*	$2,961,000	$0.50	$0.04	Q-197
Westover Hills	Conservation	2020	107	$17,233	$2.91	$1.03	Q-10
	Additional Fort Worth (TRWD)	2020	403	$0	$1.96	$1.96	None
Westworth Village	Conservation	2020	11	$11,224	$0.96	$0.00	Q-10
	Additional Fort Worth (TRWD)	2020	245	$0	$1.96	$1.96	None
White Settlement	Conservation	2020	76	$64,606	$0.98	$0.00	Q-10
	Additional Fort Worth (TRWD)	2020	1,254	$0	$1.96	$1.96	None
Tarrant County Irrigation	Conservation	2020	459	$0	$0.95	$0.95	Q-11
	Additional TRWD	2020	123	$0	$0.97	$0.97	None
Tarrant County Livestock	None	N/A	N/A	N/A	N/A	N/A	N/A
Tarrant County Manufacturing	Conservation	2020	999	$0	$0.95	$0.95	Q-11
	Additional TRWD	2020	15,139	$0	$2.50	$2.50	None

Tarrant County Mining	Additional TRWD	2030	331	$0	$0.97	$0.97	None
Tarrant County Steam Electric	Additional TRWD	2030	1,063	$0	$0.97	$0.97	None
	Direct reuse	2030	2,360	$13,080,000	$1.72	$0.29	Q-196

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

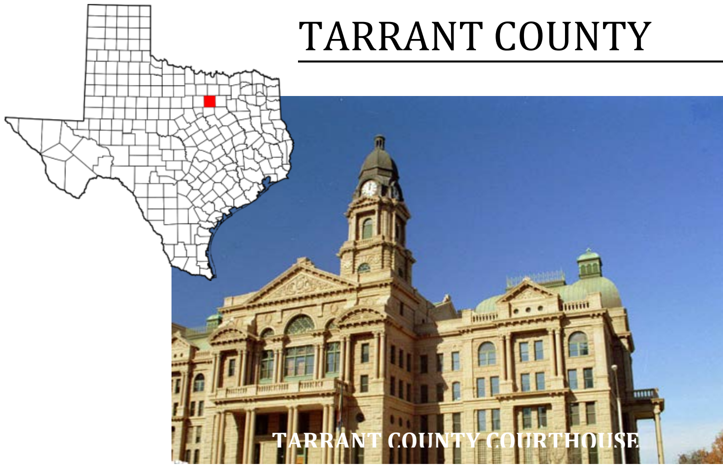
Table 5D.356
Summary of Recommended Water Management Strategies for Tarrant County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	32,123	$352,141,639
Purchase from WWP	116,241	$5,000,000
Purchase from WUG	12	$956,000
Delivery infrastructure	*37,143*	$210,595,676
Treatment plants	*3,983*	$24,761,000
Reuse	2,360	$13,080,000
Total		**$606,534,315**

* The conservation quantities represent the sum of the individual water user groups that have the majority of their service area located in this county, not the total conservation in the county.

Table 5D.357
Summary of Alternative Water Management Strategies for Tarrant County Not Covered Under Wholesale Water Providers

Type of Strategy	Entity	Quantity (Ac-Ft/Yr)	Capital Costs
Purchase unused Lake Grapevine yield from DCPCMUD	Grapevine	5,000	$0
Additional Water from TRA (TRWD) to replace groundwater	Euless	1,211	$0
Water from Euless (TRA/TRWD) to DFW Airport (in lieu of portion of Ft Worth supply)	Tarrant County Other	2,000	$100,000
Total			**$100,000**



2010 Population: *1,809,034*

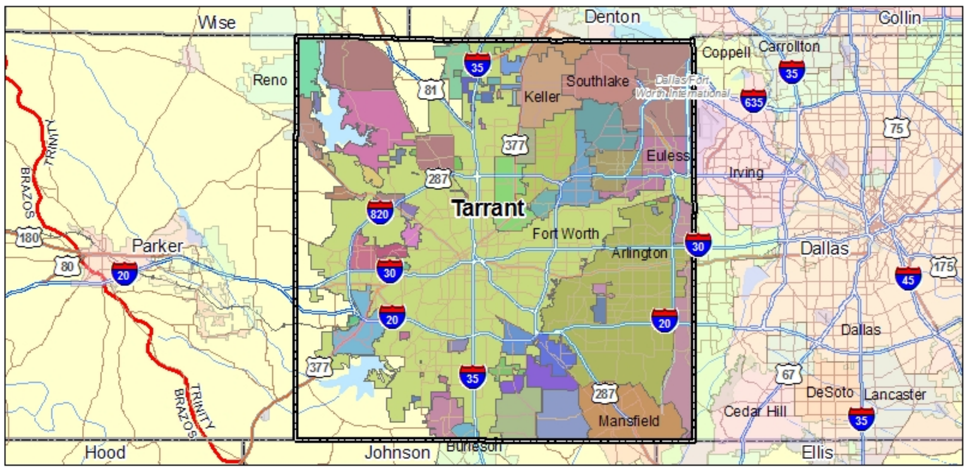
Projected 2070 Population: *3,184,348*

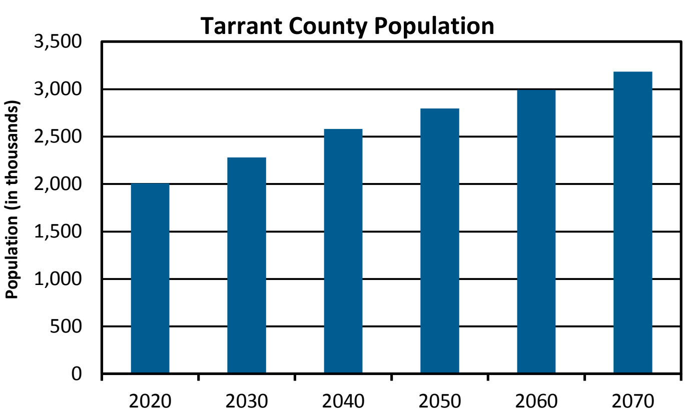
County Seat: *Fort Worth*

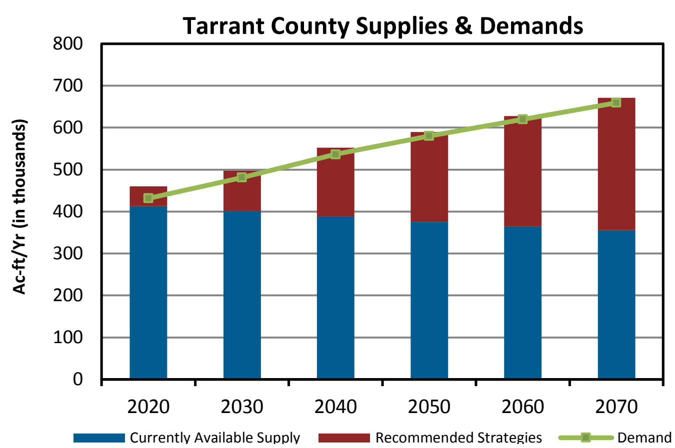
Economy: *Tourism; manufacturing*

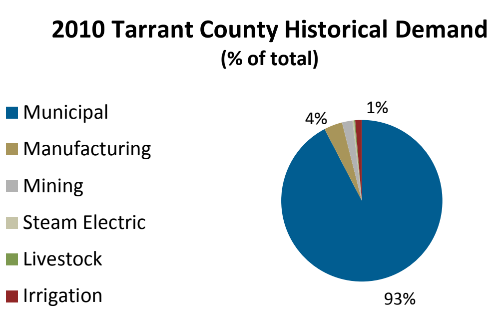
River Basin(s):

– Trinity (100%)

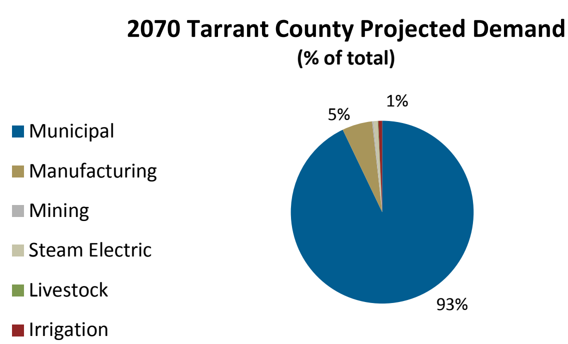








Total= 341,392 acre-feet



Total= 659,399 acre-feet

5D.16 Wise County

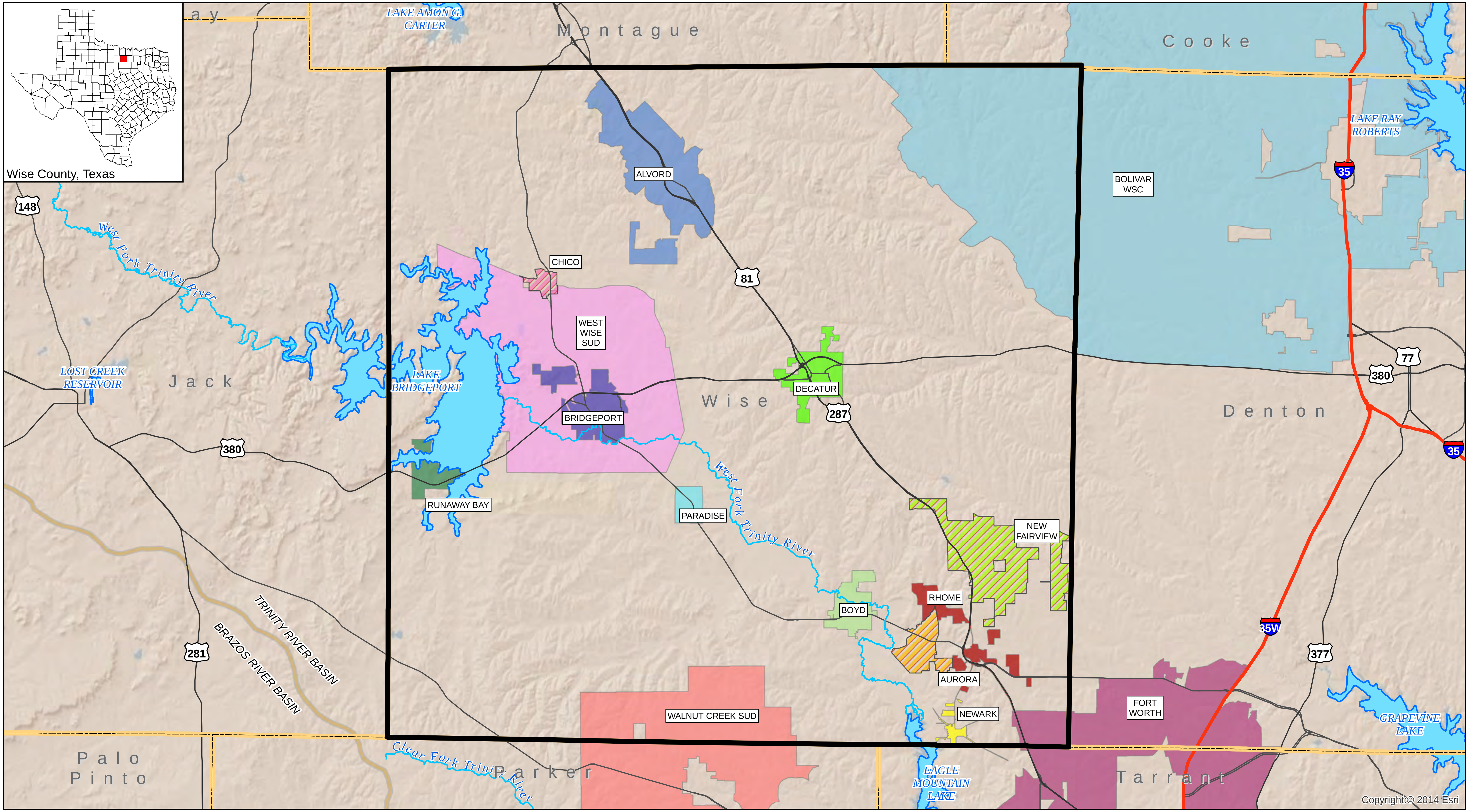
Figure 5D.16 is a map of Wise County. Wise County is in the Upper Trinity Groundwater Conservation District. Many water user groups in Wise County use groundwater supplies. The Tarrant Regional Water District (TRWD) supplies most of the remaining demand in Wise County through Walnut Creek SUD, West Wise SUD, and Wise County Water Supply District (Decatur). Water user groups that currently get water from TRWD will purchase additional water from TRWD to meet future demands. Additional supplies from sources other than groundwater and TRWD include the following:

- Bolivar Water Supply Corporation will begin purchasing water from UTRWD.
- Bolivar Water Supply Corporation will also begin purchasing water from Gainesville.

Water management strategies for Wise County water user groups are discussed on the following pages (in alphabetical order). Table 5D.375 shows the estimated capital costs for the Wise County water management strategies not associated with the wholesale water providers, and Table 5D.376 is a summary of the costs by category. Table 5D.376 is followed by a Wise County summary.

Alvord

Alvord is a city of about 1,300 in northern Wise County. The city's water supply is groundwater from the Trinity aquifer. Water management strategies for Alvord include conservation and treated water from the West Wise SUD (which gets raw water from TRWD and treated water from Walnut Creek SUD). Table 5D.358 shows the projected population and demand, the current supplies, and the water management strategies for Alvord.



FREESE AND NICHOLS

Project No: NTD11336

Service Area

County Boundary

Wise County Boundary

River Basin Divide

River

Reservoir

N W E S

1 inch = 4 miles

0 2 4 8

Miles

Data Source(s): ESRI, USGS, TNRIS

2016 Region C Water Plan

Wise County, Texas

Figure 5D.16

Table 5D.358
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Alvord

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,625**	**1,957**	**2,297**	**2,800**	**3,200**	**3,600**
Projected Water Demand						
Municipal Demand	110	132	155	189	216	242
Total Projected Water Demand	***110***	***132***	***155***	***189***	***216***	***242***
Currently Available Water Supplies						
Trinity Aquifer	151	151	151	151	151	151
Total Current Supplies	***151***	***151***	***151***	***151***	***151***	***151***
Need (Demand - Current Supply)	***0***	***0***	***4***	***38***	***65***	***91***
Water Management Strategies						
Water Conservation	1	1	2	3	4	5
West Wise SUD (TRWD)	0	0	2	35	61	86
Total Water Management Strategies	***1***	***1***	***4***	***38***	***65***	***91***
Reserve (Shortage)	**42**	**20**	**0**	**0**	**0**	**0**

Aurora

Aurora has a population of about 1,300 and is located in southeastern Wise County. The city's water supply is groundwater from the Trinity aquifer and purchased treated water from Rhome (which gets treated water from Walnut Creek SUD which in turn uses TRWD raw water). Water management strategies for Aurora include conservation and the purchase of additional treated water from Rhome. Table 5D.359 shows the projected population and demand, the current supplies, and the water management strategies for Aurora.

Table 5D.359
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Aurora

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,546**	**1,918**	**2,300**	**2,800**	**3,300**	**3,900**
Projected Water Demand						
Municipal Demand	134	159	186	224	263	311
Total Projected Demand	***134***	***159***	***186***	***224***	***263***	***311***

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Currently Available Water Supplies						
Trinity Aquifer	63	63	63	63	63	63
Rhome (from Walnut Ck. SUD, from TRWD)	71	87	99	114	113	107
Total Current Supplies	***134***	***150***	***162***	***177***	***176***	***170***
Need (Demand - Current Supply)	***0***	***9***	***24***	***47***	***87***	***141***
Water Management Strategies						
Water Conservation	1	2	2	3	4	6
Additional Rhome (from Walnut Ck. SUD, from TRWD)	0	7	22	44	83	135
Total Water Management Strategies	***1***	***9***	***24***	***47***	***87***	***141***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Bolivar Water Supply Corporation

Bolivar WSC serves wholesale and retail customers in southern Cooke County and in Denton and Wise Counties. Plans for Bolivar WSC are covered under Denton County in Section 5D.4.

Boyd

Boyd is located in southeastern Wise County and has a population of about 1,200. The city's water supply is groundwater from the Trinity aquifer and treated water from Walnut Creek SUD (which gets its raw water from TRWD). Water management strategies for Boyd include conservation and additional treated water from Walnut Creek SUD (which gets raw water from TRWD). Table 5D.360 shows the projected population and demand, the current supplies, and the water management strategies for Boyd.

Table 5D.360
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Boyd

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,303**	**1,413**	**2,000**	**2,500**	**3,500**	**3,800**
Projected Water Demand						
Municipal Demand	217	229	316	392	547	593
Total Projected Demand	***217***	***229***	***316***	***392***	***547***	***593***
Currently Available Water Supplies						
Trinity Aquifer	73	73	73	73	73	73

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Walnut Creek SUD (TRWD)	144	142	195	227	267	224
Total Current Supplies	***217***	***215***	***268***	***300***	***340***	***297***
Need (Demand - Current Supply)	***0***	***14***	***48***	***92***	***207***	***296***
Water Management Strategies						
Water Conservation	9	22	31	5	9	12
Additional Walnut Ck. SUD (TRWD)	0	0	17	87	198	284
Total Water Management Strategies	***9***	***22***	***48***	***92***	***207***	***296***
Reserve (Shortage)	**9**	**8**	**0**	**0**	**0**	**0**

Bridgeport

Bridgeport is a city of about 6,000 in western Wise County. The city buys raw water from TRWD (Lake Bridgeport) and operates its own water treatment plant. Water management strategies for Bridgeport include conservation, additional raw water from TRWD, and water treatment plant expansions which include any needed expansion for the lake intake. Table 5D.361 shows the projected population and demand, the current supplies, and the water management strategies for Bridgeport.

Table 5D.361
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Bridgeport

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**7,456**	**9,144**	**10,875**	**15,000**	**20,000**	**25,000**
Projected Water Demand						
Municipal Demand	1,294	1,551	1,822	2,496	3,322	4,149
Total Projected Demand	***1,294***	***1,551***	***1,822***	***2,496***	***3,322***	***4,149***
Currently Available Water Supplies						
Tarrant Regional Water District (limited by contract amount)	1,294	1,412	1,466	1,704	1,704	1,704
Total Current Supplies	***1,294***	***1,412***	***1,466***	***1,704***	***1,704***	***1,704***
Need (Demand - Current Supply)	***0***	***139***	***356***	***792***	***1,618***	***2,445***
Water Management Strategies						
Water Conservation	24	40	55	83	122	166

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Additional Raw Water Needed from TRWD beyond current contract with treatment as below:	0	99	301	709	1,496	2,279
2 MGD WTP Expansion				*40*	*827*	*1,121*
1.5 MGD WTP Expansion						*489*
Expand Capacity of Lake intake				*40*	*827*	*1,610*
Total Water Management Strategies	***24***	***139***	***356***	***792***	***1,618***	***2,445***
Reserve (Shortage)	**24**	**0**	**0**	**0**	**0**	**0**

Chico

Chico has a population of about 1,000 and is located in western Wise County. The city's water supply is groundwater from the Trinity aquifer and treated water from West Wise SUD (which gets raw water from TRWD and treated water from Walnut Creek SUD). Water management strategies for Chico include conservation and additional treated water from West Wise SUD with increased delivery infrastructure from West Wise SUD. Table 5D.362 shows the projected population and demand, the current supplies, and the water management strategies for Chico.

Table 5D.362
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Chico

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,051**	**1,107**	**1,165**	**2,200**	**2,800**	**3,500**
Projected Water Demand						
Municipal Demand	207	213	221	411	522	652
Total Projected Demand	***207***	***213***	***221***	***411***	***522***	***652***
Currently Available Water Supplies						
Trinity Aquifer	193	193	193	193	193	193
West Wise SUD (TRWD)	13	13	13	13	13	13
Total Current Supplies	***206***	***206***	***206***	***206***	***206***	***206***
Need (Demand - Current Supply)	***1***	***7***	***15***	***205***	***316***	***446***
Water Management Strategies						
Water Conservation	4	6	7	14	19	26
Additional West Wise SUD (TRWD)	0	1	8	191	297	420

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Increase delivery capacity from West Wise SUD	*0*	*0*	*0*	*140*	*246*	*369*
Total Water Management Strategies	***4***	***7***	***15***	***205***	***316***	***446***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Community Water Supply Corporation

Community WSC serves about 3,800 people in northwestern Tarrant County and southern Wise County. Water management strategies for Community WSC are discussed under Tarrant County in Section 5D.15.

Decatur

Decatur is located in central Wise County and has a population of about 6,200. The city's water supply is treated water from the Wise County WSD (which gets its raw water from TRWD). Water management strategies for Decatur include conservation and additional treated water from Wise County WSD. Table 5D.363 shows the projected population and demand, the current supplies, and the water management strategies for Decatur.

Table 5D.363
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Decatur

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**8,508**	**11,738**	**15,253**	**19,751**	**23,225**	**27,000**
Projected Water Demand						
Municipal Demand	2,319	3,149	4,060	5,240	6,157	7,156
Total Projected Water Demand	***2,319***	***3,149***	***4,060***	***5,240***	***6,157***	***7,156***
Currently Available Water Supplies						
Wise Co. Water Supply District (TRWD)	1,206	1,348	1,449	1,227	1,113	1,055
Total Current Supplies	***1,206***	***1,348***	***1,449***	***1,227***	***1,113***	***1,055***
Need (Demand - Current Supply)	***1,113***	***1,801***	***2,611***	***4,013***	***5,044***	***6,101***
Water Management Strategies						
Water Conservation	43	80	122	175	226	286
Additional Water from Wise Co. WSD	1,070	1,721	2,489	3,838	4,818	5,815
Total Water Management Strategies	***1,113***	***1,801***	***2,611***	***4,013***	***5,044***	***6,101***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Fort Worth

Fort Worth is a city of about 759,000 located primarily in Tarrant County, with some population in Denton, Parker, and Wise Counties. Fort Worth is a wholesale water provider, and the city's water supply plans are discussed in Section 5C.1.

New Fairview

New Fairview is a city of about 1,400 in southeastern Wise County. The city gets its water supply from the Trinity aquifer. Water management strategies for New Fairview include conservation and the purchase of treated water from Rhome (which gets treated water from Walnut Creek SUD which in turn uses TRWD raw water). Table 5D.364 shows the projected population and demand, the current supplies, and the water management strategies for New Fairview.

Table 5D.364
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of New Fairview

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,597**	**1,983**	**2,379**	**2,900**	**3,400**	**4,000**
Projected Water Demand						
Municipal Demand	163	199	236	286	334	392
Total Projected Demand	***163***	***199***	***236***	***286***	***334***	***392***
Currently Available Water Supplies						
Trinity Aquifer	163	163	163	163	163	163
Total Current Supplies	***163***	***163***	***163***	***163***	***163***	***163***
Need (Demand - Current Supply)	***0***	***36***	***73***	***123***	***171***	***229***
Water Management Strategies						
Water Conservation	1	2	2	4	6	8
Rhome (from Walnut Ck. SUD from TRWD)	0	34	71	119	165	221
Total Water Management Strategies	***1***	***36***	***73***	***123***	***171***	***229***
Reserve (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Newark

Newark has a population of about 1,000 and is located in southeastern Wise County. The city gets its water supply from the Trinity aquifer. Water management strategies for Newark include conservation and the purchase of treated water from Rhome (which gets treated water from Walnut Creek SUD which in turn uses TRWD raw water). Table 5D.365 shows the projected population and demand, the current supplies, and the water management strategies for Newark.

Table 5D.365
Projected Population and Demand, Current Supplies, and Water Management Strategies for the City of Newark

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**1,772**	**2,339**	**3,302**	**4,458**	**6,216**	**8,300**
Projected Water Demand						
Municipal Demand	195	249	345	462	643	858
Total Projected Demand	***195***	***249***	***345***	***462***	***643***	***858***
Currently Available Water Supplies						
Trinity Aquifer	195	195	195	195	195	195
Total Current Supplies	***195***	***195***	***195***	***195***	***195***	***195***
Need (Demand - Current Supply)	***0***	***54***	***150***	***267***	***448***	***663***
Water Management Strategies						
Water Conservation	2	3	3	6	11	17
Connect to Rhome (from Walnut Ck. SUD from TRWD)	0	51	147	261	437	646
Total Water Management Strategies	***2***	***54***	***150***	***267***	***448***	***663***
Reserve (Shortage)	**2**	**0**	**0**	**0**	**0**	**0**

Rhome

Rhome is a city of about 1,600 in southeastern Wise County. The city currently provides water to the city of Aurora, and will likely provide water to the cities of Newark and New Fairview in the future. Rhome's water supply is treated water from Walnut Creek SUD (which gets its raw water from TRWD) and groundwater from the Trinity aquifer. Water management strategies for Rhome include conservation and additional treated water from Walnut Creek SUD (which gets raw water from TRWD) with future increases in delivery infrastructure from Walnut Creek SUD. Table 5D.366 shows the projected population and demand, the current supplies, and the water management strategies for Rhome.

Table 5D.366
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Rhome

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**2,384**	**3,368**	**4,377**	**7,000**	**9,400**	**12,000**
Projected Water Demand						
Municipal Demand	411	571	738	1,175	1,576	2,011
Customer Demand - Aurora	71	96	123	161	200	248
Future Customer Demand - Newark	0	36	73	123	171	229
Future Customer Demand - New Fairview	0	54	150	267	448	663
Total Projected Demand	***482***	***757***	***1,084***	***1,726***	***2,395***	***3,151***
Currently Available Water Supplies						
Trinity Aquifer	280	280	280	280	280	280
Walnut Creek SUD (TRWD)	131	265	368	636	730	745
Walnut Creek SUD (TRWD) for Aurora	71	87	99	114	113	107
Total Current Supplies	***482***	***632***	***747***	***1,030***	***1,123***	***1,132***
Need (Demand - Current Supply)	***0***	***125***	***337***	***696***	***1,272***	***2,019***
Water Management Strategies						
Water Conservation	8	14	22	39	58	80
Water Conservation Aurora	1	2	2	3	4	6
Water Conservation Newark		2	2	4	6	8
Water Conservation New Fairview		3	3	6	11	17
Additional Walnut Ck. SUD (TRWD)	0	12	68	220	508	906
Additional Walnut Ck. SUD (TRWD) for Aurora	0	7	22	44	83	135
Walnut Ck. SUD (TRWD) for Newark	0	51	147	261	437	646
Walnut Ck. SUD (TRWD) for New Fairview	0	34	71	119	165	221
Increase delivery infrastructure from Walnut Creek SUD	***9***	***125***	***337***	***696***	***1,272***	***2,019***
Total Water Management Strategies	**9**	**0**	**0**	**0**	**0**	**0**
Reserve (Shortage)	8	14	22	39	58	80

Runaway Bay

Runaway Bay is located in western Wise County and has a population of about 1,300. The city buys raw water from TRWD and operates its own water treatment plant. Water management strategies for Runaway Bay include conservation, additional raw water from TRWD, and a water treatment plant expansion, which includes increasing the capacity of the lake intake. Table 5D.367 shows the projected population and demand, the current supplies, and the water management strategies for Runaway Bay.

Table 5D.367
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the City of Runaway Bay

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**1,448**	**1,633**	**1,822**	**2,200**	**2,500**	**3,000**
Projected Water Demand						
Municipal Demand	350	388	428	514	584	700
Total Projected Demand	***350***	***388***	***428***	***514***	***584***	***700***
Currently Available Water Supplies						
Tarrant Regional Water District	350	353	344	365	370	396
Total Current Supplies	***350***	***353***	***344***	***365***	***370***	***396***
Need (Demand - Current Supply)	***0***	***35***	***84***	***149***	***214***	***304***
Water Management Strategies						
Water Conservation	6	10	13	17	21	28
Additional Water from TRWD with infrastructure below:	0	25	71	132	193	276
0.5 MGD Water Treatment Plant Expansion						*100*
Increase capacity of lake intake						*100*
Total Water Management Strategies	***6***	***35***	***84***	***149***	***214***	***304***
Reserve (Shortage)	**6**	**0**	**0**	**0**	**0**	**0**

Walnut Creek Special Utility District

Walnut Creek SUD provides retail and wholesale supplies in northern Parker County and southern Wise County. The SUD is a wholesale water provider, and its water supply plans are discussed in Section 5C.

West Wise Special Utility District

West Wise SUD serves about 3,000 people in western Wise County and provides water to Chico. The SUD buys raw water from TRWD and operates its own water treatment plant and buys treated water from Walnut Creek SUD (which also gets its raw water from TRWD). Water management strategies for West Wise SUD include conservation, additional raw water from TRWD, and additional treatment capacity. Table 5D.368 shows the projected population and demand, the current supplies, and the water management strategies for West Wise SUD.

Table 5D.368
Projected Population and Demand, Current Supplies,
and Water Management Strategies for West Wise Special Utility District

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Population	**3,459**	**3,580**	**3,705**	**3,835**	**3,969**	**4,108**
Projected Water Demand						
Municipal Demand	425	424	427	435	449	464
Demand for Chico	14	20	28	218	329	459
Total Projected Demand	***439***	***444***	***455***	***653***	***778***	***923***
Currently Available Water Supplies						
Tarrant Regional Water District (direct 95% and through Walnut Creek SUD 5%)	425	386	344	310	283	260
Tarrant Regional WD (direct 95% and through Walnut Creek SUD 5%) for Chico	13	13	13	13	13	13
Total Current Supplies	***438***	***399***	***357***	***323***	***296***	***273***
Need (Demand - Current Supply)	***1***	***45***	***98***	***330***	***482***	***650***
Water Management Strategies						
Water Conservation (West Wise SUD only)	4	5	4	6	7	9
Additional Water from TRWD with Infrastructure below:	0	40	94	324	475	641
0.8 MGD Water Treatment Plant Expansion				*54*	*172*	*308*
Total Water Management Strategies	***4***	***45***	***98***	***330***	***482***	***650***
Reserve (Shortage)	**3**	**0**	**0**	**0**	**0**	**0**

Wise County Irrigation

Table 5D.369 shows the projected demand, the current supplies, and the water management strategies for Wise County Irrigation. The current supplies are local surface water supplies, groundwater from the Trinity aquifer, and water from the Tarrant Regional Water District. Water management strategies for Wise County Irrigation include conservation and additional water supplied by the Tarrant Regional Water District.

Table 5D.369
Projected Population and Demand, Current Supplies, and Water Management Strategies for the Wise County Irrigation

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Water Demand	**1,324**	**1,324**	**1,324**	**1,324**	**1,324**	**1,324**
Currently Available Water Supplies						
Local Supplies	139	139	139	139	139	139
Trinity Aquifer	680	680	680	680	680	680
Tarrant Regional Water District	124	124	124	124	124	124
Total Current Supplies	***943***	***943***	***943***	***943***	***943***	***943***
Need (Demand - Current Supply)	***381***	***381***	***381***	***381***	***381***	***381***
Water Management Strategies						
Water Conservation	0	0	1	1	1	1
Add'l TRWD (new contract)	406	406	405	405	405	405
Total Water Management Strategies	***406***	***406***	***406***	***406***	***406***	***406***
Reserve (Shortage)	**25**	**25**	**25**	**25**	**25**	**25**

Wise County Livestock

Table 5D.370 shows the projected demand, current supplies, and water management strategies for Wise County Livestock. The current supplies are local surface water supplies and groundwater from the Trinity aquifer. These sources are sufficient to meet projected demands, and there are no water management strategies for this water user group.

Table 5D.370
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Wise County Livestock

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,575**	**1,575**	**1,575**	**1,575**	**1,575**	**1,575**
Currently Available Water Supplies						
Trinity Aquifer	458	458	458	458	458	458
Local Supplies	1,117	1,117	1,117	1,117	1,117	1,117
Total Current Supplies	***1,575***	***1,575***	***1,575***	***1,575***	***1,575***	***1,575***
Need (Demand - Current Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
None						
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wise County Manufacturing

Table 5D.371 shows the projected demand and current supplies for Wise County Manufacturing. Current supplies are water from the TRWD through numerous water suppliers in the county and groundwater (Trinity Aquifer). The water management strategies for this water user group are conservation, additional water from TRWD, and new wells in the Trinity Aquifer.

Table 5D.371
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Wise County Manufacturing

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**2,660**	**2,979**	**3,277**	**3,539**	**3,858**	**4,206**
Currently Available Water Supplies						
Trinity Aquifer	250	250	250	250	250	250
TRWD (direct)	2,022	2,128	2,117	2,077	2,059	2,035
TRWD (through Wise Co WSD)	138	128	117	83	70	62
Total Current Supplies	***2,410***	***2,506***	***2,484***	***2,410***	***2,379***	***2,347***
Need (Demand - Current Supply)	***250***	***473***	***793***	***1,129***	***1,479***	***1,859***

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Water Management Strategies						
Water Conservation	0	0	1	1	1	1
Additional water from TRWD	0	223	542	878	1,228	1,608
New Wells in Trinity Aquifer	250	250	250	250	250	250
Total Water Management Strategies	***250***	***473***	***793***	***1,129***	***1,479***	***1,859***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wise County Mining

Table 5D.372 shows the projected demand, the current supplies, and the water management strategies for Wise County Mining. Wise County Mining is supplied from reuse, run-of-river water from the Trinity River, raw water from TRWD, and the Trinity aquifer. The water management strategies for this water user group are additional water from TRWD and on-site recycling of process water (reuse). Conservation was a considered strategy for this water user group, but not recommended because of the uncertainty in the ability to implement conservation measures given the multiple companies, industries, facilities, and types of processes that make up this WUG. A reuse strategy has been recommended in lieu of a conservation strategy.

Table 5D.372
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Wise County Mining

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**10,320**	**11,159**	**12,337**	**13,975**	**15,378**	**17,694**
Currently Available Water Supplies						
Reuse	6,261	6,261	6,261	6,261	6,076	6,076
Run-of-river - Trinity	133	133	133	133	133	133
Trinity Aquifer	2,155	2,155	2,155	2,155	2,155	2,155
Tarrant Regional Water District (direct & through Bridgeport)	2,896	2,896	2,896	2,896	2,896	2,896
Total Current Supplies	***11,445***	***11,445***	***11,445***	***11,445***	***11,260***	***11,260***
Need (Demand - Current Supply)	***0***	***0***	***892***	***2,530***	***4,118***	***6,434***
Water Management Strategies						
Add'l Water from TRWD (increase contract)	200	452	805	1,297	1,717	2,412
Reuse - Recycled water	0	0	87	1,234	2,401	4,022

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Total Water Management Strategies	***200***	***452***	***892***	***2,531***	***4,118***	***6,434***
Reserve (Shortage)	**1,325**	**738**	**0**	**1**	**0**	**0**

Wise County Other

Wise County Other includes individual domestic supplies and other water suppliers too small to be classified as water user groups. Wise County Other has about 30,000 people, and that number is expected to grow. Wise County other supplies come from the TRWD and groundwater (Trinity aquifer). Water management strategies for Wise County Other include conservation and additional water from the TRWD. Table 5D.373 shows the projected population and demand, the current supplies, and the water management strategies for Wise County Other.

Table 5D.373
Projected Population and Demand, Current Supplies,
and Water Management Strategies for Wise County Other

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2020	2030	2040	2050	2060	2070
Projected Population	**30,543**	**30,543**	**30,543**	**45,000**	**58,000**	**70,000**
Projected Water Demand						
Municipal Demand	3,667	3,565	3,485	5,039	6,465	7,794
Total Projected Demand	***3,667***	***3,565***	***3,485***	***5,039***	***6,465***	***7,794***
Currently Available Water Supplies						
Trinity Aquifer	2,584	2,584	2,584	2,584	2,584	2,584
Tarrant Regional Water District through Wise County WSD	506	374	284	540	667	733
Tarrant Regional Water District through Walnut Creek SUD	110	97	84	107	109	101
Total Current Supplies	***3,200***	***3,055***	***2,952***	***3,231***	***3,360***	***3,418***
Need (Demand - Current Supply)	***467***	***510***	***533***	***1,808***	***3,105***	***4,376***
Water Management Strategies						
Water Conservation	31	42	35	67	108	156
Additional TRWD (through Wise County WSD and Walnut Creek SUD)	436	468	498	1,741	2,997	4,220
Total Water Management Strategies	***467***	***510***	***533***	***1,808***	***3,105***	***4,376***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Wise County Steam Electric Power

Table 5D.374 shows the projected demand, the current supplies, and the water management strategies for Wise County Steam Electric Power. Wise County Steam Electric Power is supplied by raw water from TRWD. The water management strategy for Wise County Steam Electric Power is additional water from TRWD. Conservation was a considered strategy for this water user group, but not recommended because the steam electric demand projections themselves considered items such as future efficiency programs.

Table 5D.374
Projected Population and Demand, Current Supplies,
and Water Management Strategies for the Wise County Steam Electric

(Values in Ac-Ft/Yr)	Projected Demand					
	2020	2030	2040	2050	2060	2070
Projected Water Demand	**1,494**	**1,459**	**2,254**	**2,450**	**3,298**	**3,673**
Currently Available Water Supplies						
Tarrant Regional Water District	1,494	1,328	1,813	1,741	2,091	2,078
Total Current Supplies	***1,494***	***1,328***	***1,813***	***1,741***	***2,091***	***2,078***
Need (Demand - Current Supply)	***0***	***131***	***441***	***709***	***1,207***	***1,595***
Water Management Strategies						
Additional water from TRWD	0	131	441	709	1,207	1,595
Total Water Management Strategies	***0***	***131***	***441***	***709***	***1,207***	***1,595***
Reserve (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Costs for Wise County Water User Groups

Table 5D.375 shows the estimated capital costs for Wise County water management strategies not covered under the wholesale water providers. Table 5D.376 summarizes the costs by category and is followed by a summary for Wise County.

Table 5D.375
Costs for Recommended Water Management Strategies for Wise County Not Covered Under Wholesale Water Providers

Water User Group	Strategy	Imple-mented by:	Quantity** (Ac-Ft/Yr)	Capital Costs	Unit Cost ($/1000 gal)		Table for Details
					With Debt Service	After Debt Service	
Alvord	Conservation	2020	5	$1,611	$0.41	$0.00	Q-10
	West Wise Rural SUD (TRWD)	2020	86	$0	$2.50	$2.50	None
Aurora	Conservation	2020	6	$2,325	$0.60	$0.00	Q-10
	Rhome (TRWD through Walnut Creek SUD)	2020	135	$0	$5.25	$5.25	None
Bolivar WSC*	Conservation	See Denton County.					
	UTRWD supplies	See Denton County.					
	Connect to Gainesville	See Denton County.					
Boyd	Conservation	2020	12	$6,674	$13.16	$0.00	Q-10
	Additional Walnut Creek SUD	2020	284	$0	$5.25	$5.25	None
Bridgeport	Conservation	2020	166	$84,181	$3.53	$1.16	Q-10
	Additional TRWD	2040	2,279	$0	$0.97	$0.97	None
	2 MGD WTP Expansion	*2050*	*1,121*	$8,911,000	$2.91	$0.87	Q-13
	1.5 MGD WTP Expansion	*2070*	*489*	$7,844,000	$5.88	$1.76	Q-13
	Expand Capacity of Lake intake and Pump Station	*2050*	*1,610*	$766,100	$0.15	$0.03	Q-200
Chico	Conservation	2020	26	$4,423	$2.69	$1.16	Q-10
	Additional West Wise Rural SUD	2030	420	$0	$2.50	$2.50	None
	Increase delivery capacity from West Wise SUD	*2050*	*369*	$3,610,000	$2.89	$0.38	Q-201
Decatur	Conservation	2020	286	$238,239	$3.10	$0.70	Q-10
	Additional Wise County WSD	2020	5,815	$0	$2.50	$2.50	None
Fort Worth*	Conservation	See Tarrant County					
	Other measures	See Fort Worth in Section 5C.1.					

New Fairview	Conservation	2020	8	$2,968	$0.76	$0.00	Q-10
	Supply from Rhome	2030	221	$0	$2.50	$2.50	None
	Connect to Rhome (TRWD through Walnut Creek SUD)	*2030*	*221*	$3,662,000	$4.97	$0.73	Q-202
Newark	Conservation	2020	17	$3,978	$0.51	$0.00	Q-10
	Supply from Rhome	2030	646	$0	$2.50	$2.50	None
	Connect to Rhome (TRWD through Walnut Creek SUD)	*2030*	*646*	$2,548,000	$1.14	$0.13	Q-203
Rhome	Conservation	2020	80	$3,921	$2.72	$1.23	Q-10
	Additional Walnut Creek SUD	2020	906	$0	$5.25	$5.25	None
Runaway Bay	Conservation	2020	28	$6,539	$2.44	$0.93	Q-10
	Additional TRWD	2030	276	$0	$0.97	$0.97	None
	0.5 MGD Water Treatment Plant Expansion	*2070*	*100*	$4,078,000	$14.90	$4.46	Q-13
	Increase capacity of lake intake	*2070*	*100*	$52,500	$0.16	$0.03	Q-204
Walnut Creek SUD*	Conservation	See Parker County.					
	Other measures	See Walnut Creek SUD in Section 5C.2.					
West Wise SUD	Conservation	2020	9	$23,121	$1.48	$0.00	Q-10
	Additional TRWD	2030	641	$0	$0.97	$0.97	None
	0.8 MGD Water Treatment Plant Expansion	*2050*	*308*	$5,697,000	$6.78	$2.03	Q-13
Wise County Other	Conservation	2020	156	$87,859	$0.73	$0.00	Q-10
	Additional TRWD (through Wise Co WSD and Walnut Creek SUD)	2020	4,220	$0	$5.25	$5.25	None
Wise County Irrigation	Conservation	2040	1	$0	$0.95	$0.95	Q-11
	Additional TRWD	2020	406	$0	$0.97	$0.97	None
Wise County Livestock	None	N/A	N/A	N/A	N/A	N/A	N/A
Wise County Manufacturing	Conservation	2020	1	$0	$0.95	$0.95	Q-11
	Additional TRWD	2020	1,608	$0	$0.97	$0.97	None
	New wells	2020	250	$1,636,600	$2.32	$0.64	Q-205

Wise County Mining	Additional TRWD	2020	2,412	$0	$0.97	$0.97	None
	Reuse	2020	4,022	$0	$0.50	$0.50	None
Wise County Steam Electric	Additional TRWD	2020	1,595	$0	$0.97	$0.97	None

Notes: Water User Groups marked with an * extend into more than one county.
**Quantities listed are for the WUG only. They do not include the WUG's customers.

Table 5D.376
Summary of Recommended Water Management Strategies for Wise County Not Covered Under Wholesale Water Providers

Type of Strategy	Quantity (Ac-Ft/Yr)	Capital Costs
Conservation*	801	$465,839
Purchase from WWP	20,528	$0
Purchase from WUG	1,422	$0
Delivery infrastructure	*2,946*	$10,638,600
Treatment plants	*2,018*	$26,530,000
Reuse	4,022	$0
Groundwater	250	$1,636,600
Total		**$39,271,039**

* The conservation quantities represent the sum of the individual water user groups who have the majority of their service areas located in the county, not the total conservation in the county.

WISE COUNTY

SUMMARY

2010 Population: *59,127*

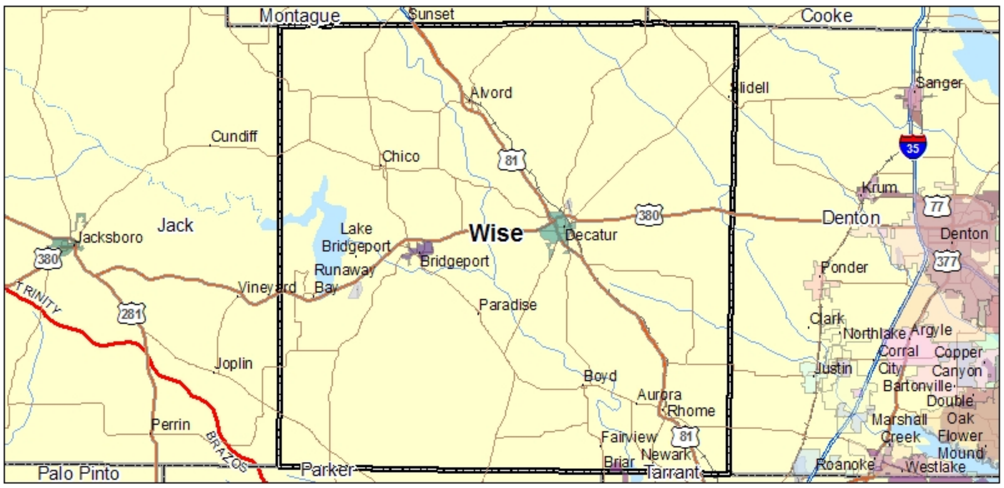
Projected 2070 Population: *227,527*

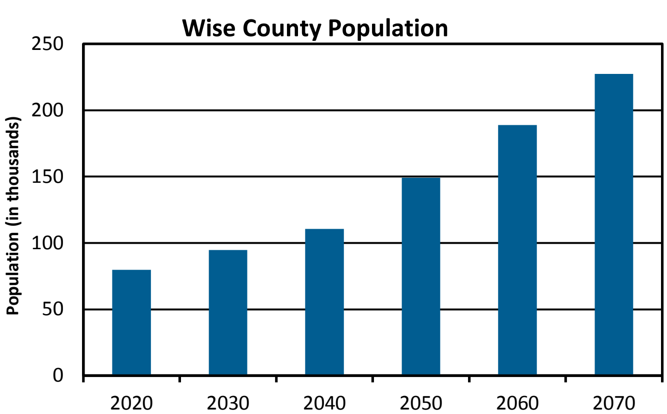
County Seat: *Decatur*

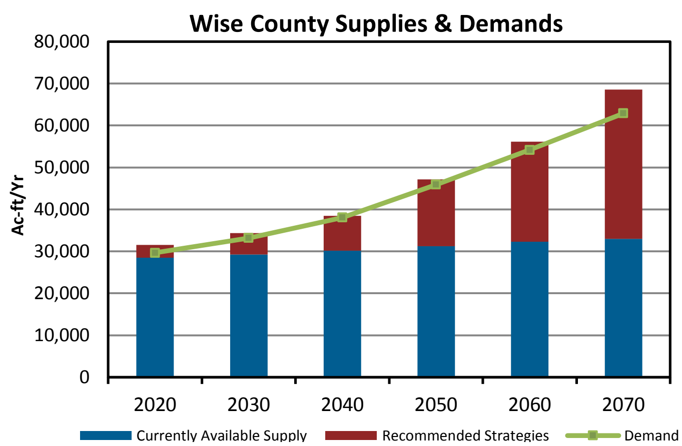
Economy: *Petroleum; sand and gravel; agribusiness*

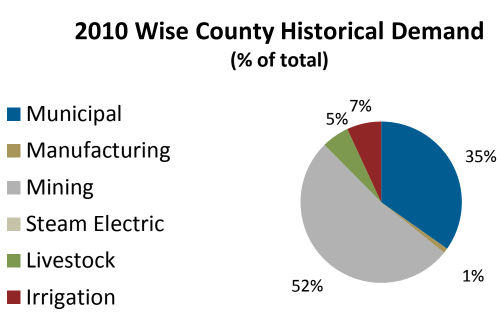
River Basin(s):

- Trinity (100%)

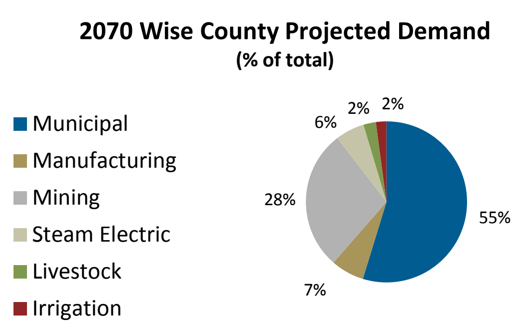








Total= 23,072 acre-feet



Total= 62,906 acre-feet

SECTION 5D
LIST OF REFERENCES

(1) R.W. Harden and Associates, Inc., HDR Engineering, Inc., LBG-Guyton Associates, Freese and Nichols, Inc., United States Geological Survey, and Dr. Joe Yelderman: *Northern Trinity/Woodbine Aquifer Groundwater Availability Model*, prepared for the Texas Water Development Board, Austin, August 31, 2004.

(2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2006.

(3) Mid-East Texas Groundwater Conservation District created by the Texas Legislature, Chapter 1507, Art. 4 (HB 1784) and Ch. 966, Art. 3, Part 15, (SB 1), 77th Leg., September 2001, confirmed November 2002.

(4) Lesikar, B., R. Kaiser, V. Silvy, *Questions about Groundwater Conservation Districts in Texas*, published by the Texas Cooperative Extension, College Station, June 2002.

(5) Neches and Trinity Valleys Groundwater Conservation District created by the Texas Legislature, Ch. 1387, 77th Leg., September 2001 (SB 1821), confirmed November 2001.

5E Water Conservation and Reuse Recommendations

During development of this plan, the Region C Water Planning Group placed strong emphasis on water conservation and reuse as a means of meeting projected water needs. This section consolidates the water conservation recommendations in the *2016 Initially Prepared Region C Water Plan*, presenting an introduction (Section 5E.1); definitions (Section 5E.2); a summary of information developed since the *2011 Region C Water Plan* (Section 5E.3); a summary of Region C Water Planning Group decisions regarding water conservation and reuse (Section 5E.4); a discussion of historical water use in Region C and other regions (Section 5E.5), a discussion of existing water conservation and reuse in Region C (Section 5E.6); a discussion of recommended water conservation and reuse in Region C (Section 5E.7); a review of the projected per capita use in Region C with the recommended strategies (Section 5E.8), a list of water conservation policy recommendations (Section 5E.9); and a discussion of water conservation plans and reporting requirements (Section 5E.10). An evaluation of consistency of the *2016 Initially Prepared Region C Water Plan* with the water conservation planning requirements is presented in Section 5E.11.

5E.1 Introduction

In the *2011 Region C Water Plan* [1], the recommended water management strategies for Region C were projected to achieve water conservation savings of 8.9 percent of the total projected water demand for the region by 2060. This 8.9 percent savings was in addition to the water conservation savings (primarily from low-flow plumbing fixture rules) that were already assumed in the water demand projections. The Region C Water Planning Group adopted the following strategies in the 2011 Plan to pursue water conservation:

- Active municipal measures were categorized based on potential for water savings, opinions of probable cost, and likelihood of implementation. The Basic Water Conservation Package, which was recommended for every municipal water user group (WUG) in Region C, included the following measures:
  - Low flow plumbing fixtures (included in water demand projections)
  - Public and school education
  - Water use reduction due to increasing water prices
  - Water system audit, leak detection and repair, and pressure control

- New efficient residential clothes washer standards
  - Water conservation pricing structure
  - Water waste prohibition
- The Expanded Water Conservation Package, which was recommended for 145 of the 277 municipal WUGs in the 2011 Region C Plan, included the following measures:
  - Coin-operated clothes washer rebate
  - Residential customer water audit
  - Landscape irrigation restrictions
  - Industrial, commercial, and institutional (ICI) water audit, water waste reduction, and site-specific conservation program
  - Reuse of treated wastewater effluent
- Active non-municipal measures included manufacturing and irrigation rebates.
- Encourage adequate state funding for the Water Conservation Advisory Council (WCAC) and for a statewide water conservation awareness campaign.
- Encourage the Texas Water Development Board (TWDB) and Texas Commission on Environmental Quality (TCEQ) to work with the Federal government on Section 316(b) regulations to allow the efficient use and conservation of water supplies for power plants.

Since the Region C Water Planning Group made these recommendations, new water conservation studies have been produced, and the TWDB has updated the regional water planning rules [(2)]. Relevant water conservation legislation passed since 2011 will also have an effect on recommended water conservation strategies. New information is discussed below, following a review of the definitions of conservation and drought management measures.

5E.2 Definitions

The Texas Water Code §11.002(8) defines *conservation* as "the development of water resources; and those practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses." By this definition, it is clear that reuse of treated wastewater effluent is a water conservation measure.

Although water conservation measures and drought or emergency water management measures both save water, water conservation measures are fundamentally different from drought or emergency management measures. *Drought/emergency management measures* are temporary measures that are implemented when certain criteria are met and are terminated when these criteria are no longer met, while *water conservation measures* are designed to provide permanent or long-term water savings.

5E.3 Information Developed Since *2011 Region C Water Plan*

Since the *2011 Region C Water Plan*, the Texas Legislature has implemented new water conservation legislation in two sessions, and the WCAC and the TWDB have developed new water conservation information. These new developments are summarized in the following sections.

5E.3.1 Water Conservation Legislation and Implementation: 82nd Texas Legislature

In the 82nd Regular Session, the Texas Legislature (2011) passed two bills, Senate Bill 181 and Senate Bill 660, which have a direct bearing on water conservation and regional water planning. SB 181 directed the TCEQ and the TWDB to work with the Water Conservation Advisory Council (WCAC) to develop a uniform, consistent methodology and guidance for calculating water use and conservation by cities and water utilities. In response, these entities published Guidance and Methodology for Reporting on Water Conservation and Water Use [(3)] in December 2012. The methodology includes methods for calculating the following:

- Total water use, including billed water and nonrevenue water
- Water use by sector
- Total water use in gallons per capita per day (gpcd)
- Residential water use in gpcd, including both single-family and multi-family users
- Water use in other sectors normalized by factors other than population or number of customers
- The water use reporting methodology also includes guidance on determining service populations, including permanent and temporary populations.

SB 181 further directed TWDB, in consultation with the TCEQ and the WCAC, to develop a data collection and reporting program for cities and water utilities with more than 3,300 connections. Under this program, an entity must report the most detailed level of water use data currently available to the entity. The TCEQ may not require an entity to report water use data that is more detailed than the entity's billing system is capable of producing but may require that billing systems purchased after September 1, 2011, be capable of reporting detailed water use data. In response to these directives, the following forms have been updated:

- Annual water use surveys (TWDB)
- Water conservation plan annual reports (TWDB and TCEQ)
- Utility profiles (TWDB and TCEQ).

Finally, SB 181 required regional water planning groups to include in regional water plans information on:

- Projected water use and conservation in the regional water planning area and
- Implementation of state and regional water plan projects, including water conservation strategies, necessary to meet the state's projected water demands.

SB 660 required that water conservation plans use the methodology and guidance for calculating water use and conservation (from SB 181). SB 660 also established that data included in a water conservation plan or required report must be interpreted in the context of variations in local water use. In addition, these data may not be the only factor considered by the TCEQ in determining the highest practicable level of water conservation and efficiency achievable in the jurisdiction of a municipality or water utility for purposes of Section 11.085(l).

5E.3.2 Water Conservation Legislation and Implementation: 83rd Texas Legislature

In the 83rd Regular Session, the Texas Legislature (2013), via the passage of House Bill 4, outlined the structure, administration, and oversight of the State Water Implementation Fund for Texas (SWIFT) and the State Water Implementation Revenue Fund for Texas (SWIRFT), including a prioritization process for projects and the creation of a legislative advisory committee. The SWIFT and the SWIRFT support low-cost financing of water projects in the State Water Plan through the issuance of bonds with subsidized interest rates, longer repayment terms, incremental repayment terms, and deferral periods. HB 4 dedicated at least 10 percent of this funding for rural political subdivision or agricultural water conservation and at least 20 percent of this funding for water conservation or reuse projects. The legislature also amended the Texas Constitution to create the SWIFT and the SWIRFT (Senate Joint Resolution 1) and authorized a one-time $2 billion transfer from the Texas Economic Stabilization Fund (the “Rainy Day Fund”) to finance the SWIFT and the SWIRFT, pending voter approval (House Bill 1025).

Since passage of HB 4, the following steps have been taken to implement SWIFT/SWIRFT funding:

- On November 5, 2013, state voters approved Proposition 6, which finalized the transfer of $2 billion from the Rainy Day Fund.
- The TWDB created a Stakeholder Committee (SHC) consisting of the chairs of the 16 regional water planning groups (or their designees) to develop uniform standards for prioritizing regional water plan projects for SWIFT funding. On November 25, 2013, the SHC submitted uniform standards for prioritization [(4)]. The associated scoring system consists of the following criteria (weightings shown in parentheses):
    - Decade of need (40%)
    - Project feasibility (10%)
    - Project viability (25%)
    - Project sustainability (25%)

- Project cost effectiveness (10%)

- The TWDB solicited public input on SWIFT implementation during various meetings from January through September 2014.
- The regional water planning groups submitted final prioritization of projects from the 2011 regional water plans on September 1, 2014.
- The TWDB approved SWIFT implementation rules on November 6, 2014.

To date TWDB has accomplished the following actions to complete the first round of SWIFT funding:

- November 2014 through February 2015: Accepted abridged applications for SWIFT funding.
- Spring 2015: Considered prioritization of applications, identified amount of funds available by category, invited applicants to submit full financial applications, and received complete applications.
- Summer 2015: Considered and approved applications and authorized bond sale.
- Fall 2015: Completed bond sale, completed bond closing, and closed borrower loans.

The 83rd Legislature also required retail public utilities that supply potable water to more than 3,300 connections or receive financial assistance from the TWDB to file an annual water audit with the TWDB (House Bill 857). The legislature also increased penalties for water rights holders who fail to file a water rights use report with the TCEQ or fail to make information available to the TCEQ (House Bill 2615). These requirements are designed to improve the data available for regional water planning.

5E.3.3 Water Conservation Advisory Council

In 2007, the 80th Texas Legislature created the Water Conservation Advisory Council, a group consisting of 23 experts representing various agencies, political subdivisions, water users, and interest groups. The WCAC is charged with the following duties:

- Monitoring trends in water conservation implementation;
- Monitoring new technologies for possible inclusion as best management practices;
- Monitoring the effectiveness of the statewide water conservation public awareness program and associated local involvement in implementation of the program;
- Developing and implementing a state water management resource library;
- Developing and implementing a public recognition program for water conservation;
- Monitoring the implementation of water conservation strategies by water users included in regional water plans; and

- Monitoring target and goal guidelines for water conservation to be considered by the TWDB and TCEQ.

Each biennium, the WCAC reports on the progress of water conservation in Texas. In the December 2012 report, reported achievements included [5]:

- Municipal water conservation plans addressing about 80 percent of water used for municipal purposes in Texas have been developed and filed with the TWDB and the TCEQ. Annual water conservation implementation reports submitted by municipal water users for 2011 indicate water conservation savings of 75.7 billion gallons (6.4 percent of total water provided), reuse of 67.4 billion gallons of reclaimed water, and average water loss of 12.2 percent.
- A statewide study of agricultural best management practices implementation through the Texas State Soil and Water Conservation Board and U.S. Department of Agriculture-Natural Resources Conservation Service programs identified water savings of 475,000 acre-feet over a 3-year period [6].
- Many larger cities have developed or are developing specific programs to reach industrial, commercial, and institutional (ICI) sectors.
- State-sponsored water conservation public awareness campaigns include:
    - The TWDB manages "Water IQ: Know Your Water," a statewide program that supports existing local water conservation programs and efforts (www.wateriq.org).
    - The Texas Parks and Wildlife Department (TWPD) has produced "The State of Water," a documentary series exploring the crucial issues facing water in Texas, and it devotes each July issue of Texas Parks & Wildlife magazine to water issues. The TWPD has developed a web site (www.texasthestateofwater.org) featuring these items and other water conservation resources.
    - The Texas Department of Agriculture, the TWDB, the TCEQ, and a diverse public-private coalition developed "Texas Water Smart" to educate businesses and families on simple, proactive steps to conserve water (www.texaswatersmart.com).
- Featured Region C water conservation public awareness campaigns included the North Texas Municipal Water District's Water IQ campaign (www.northtexaswateriq.org) and the joint Tarrant Regional Water District-Dallas Water Utilities campaign "Save water. Nothing can replace it." (www.savetarrantwater.com and www.savedallaswater.com).
- The WCAC determined that participating in a national clearinghouse of water conservation literature, information, and tools was preferable to developing an independent water conservation library for Texas. Therefore, the WCAC elected to add Texas-specific information to the Alliance for Water Efficiency's Resource Library (www.allianceforwaterefficiency.org/resource-library/default.aspx).
- The WCAC created the Blue Legacy Awards to recognize water conservation in the municipal and agricultural sectors. Region C recipients have included the North Texas Municipal Water District for its water conservation public awareness campaign (2011), the City of McKinney's Office of Environmental Stewardship for its public awareness outreach program (2012), the City of Fort Worth Water Department for its SmartWater ICI Audit Program (2013), the City of Frisco for its evidence-based educational approach to water conservation (2015), and the North Texas

Municipal Water District for its collaborative effort with the Irrigation Technology Program of the Texas A&M AgriLife Extension Service to provide its customer with weather-based irrigation recommendations (2015).

The WCAC also recommended advancements in water conservation monitoring and implementation in its December 2012 report, including [5]:

- Enhanced promotion of the Water Conservation Best Management Practices Guide [7] as a resource for development of water conservation plans.
- Improved guidance to assist water suppliers in providing the most accurate and current water use data and water conservation savings estimates.
- Expanded data collection efforts that include all water providers and water use categories.
- Development of sector-based water data reporting using sector-specific metrics.

As described previously, the WCAC worked with the TCEQ and the TWDB to develop a uniform, consistent methodology and guidance for calculating water use and conservation by cities and water utilities [3].

In addition, the WCAC works with the TWDB and the TCEQ to develop new water conservation best management practices (BMPs) and to review and update the BMPs originally published in 2004 [7]. The most current BMPs can be accessed at www.twdb.texas.gov/conservation/bmps/index.asp.

5E.3.4 Water Conservation Savings Quantification Study

The TWDB contracted for a *Water Conservation Savings Quantification Study* to identify and evaluate potential methods to assist in evaluating actual water savings being achieved by municipal water conservation efforts [8]. In the initial round of annual water conservation implementation reports filed with the TWDB, many providers reported zero (or near-zero) water savings or did not estimate their water savings. Based on literature review, review of water conservation plans and annual implementation reports, and interviews with municipal water providers, the study made the following recommendations:

- Based on the municipal water use data that it already collects, the TWDB should develop a "top-down" statistical analysis methodology for estimating statewide and/or regional water conservation savings.
- The TWDB should develop a desktop tool to promote standardized water use reporting and analysis and to facilitate evaluation of water conservation programs.
- In conjunction with other state, regional, and local agencies, the TWDB should develop a common water data collection and reporting system that would streamline water data reporting and create a robust database of water usage data.

In coordination with the TCEQ, the TWDB has also contracted for a Direct Potable Water Reuse Research Project (in progress), which will provide scientific and technical information related to the implementation of direct potable reuse projects in Texas. The study will identify safe and practical approaches applicable to Texas and provide advice on how utilities can plan and implement projects. This project is being conducted with input and feedback from water utility stakeholders throughout the state and is scheduled to be completed in 2015.

5E.3.5 New Regional Planning Requirements

The TWDB has revised its planning guidelines since the last round of regional water planning. New water conservation-related requirements include:

- A secondary water needs analysis for all WUGs and WWPs for which conservation water management strategies or direct reuse water management strategies are recommended. This secondary water needs analysis will calculate the water needs that would remain after assuming all recommended conservation and direct reuse water management strategies are fully implemented [31 TAC §357.33(e)].
- Consideration of water conservation practices for each identified water need must include potentially applicable BMPs [31 TAC §357.34(f)(2)].
- Consideration of potentially applicable BMPs when developing water conservation strategies for each WUG or WWP that is to obtain water from a proposed interbasin transfer to which Texas Water Code §11.085 (relating to Interbasin Transfers) applies [31 TAC §357.34(f)(2)(C)].
- A description of the level of implementation of previously recommended water management strategies [31 TAC §357.45(a)].

A summary of all water conservation-related regional planning requirements and how they have been addressed in Region C is presented in Section 5E.11.

5E.4 Summary of Region C Water Planning Group Decisions

TWDB planning rules require Regional Water Planning Groups (RWPGs) to "evaluate potentially feasible water management strategies for all water user groups (WUGs) and wholesale water providers (WWPs) with identified water needs," including water conservation measures and reuse of treated wastewater effluent. This section summarizes the decisions of the Region C Water Planning Group for these water management strategies.

5E.4.1 Water Conservation

As discussed above, the legislature, the WCAC, and the TWDB have been active in the area of water conservation since the development of the *2011 Region C Water Plan* [1]. New information about the potential for water conservation in Region C has been developed, and the revised planning rules require incorporation of water conservation strategies for certain water user groups.

Summary of Decision: Incorporate water management strategies involving water conservation as a major component of the long-term water supply for Region C. Encourage planning and implementation of water conservation projects. Monitor legislation and regulatory actions related to water conservation.

5E.4.2 Reuse of Treated Wastewater Effluent

Reuse of treated wastewater effluent is becoming an increasingly important source of water in Region C and across the state of Texas. The *2011 Region C Water Plan* [1] projected that the reuse of reclaimed water would provide supply equal to approximately 16 percent of the 2060 Region C water supply. There are a number of water reuse projects in operation in Region C, and many others are currently in the planning and permitting process. Reuse will serve a major role in meeting future water supply requirements for the region.

Direct reuse and indirect reuse have significantly different permitting requirements and potential applications. Direct reuse occurs when treated wastewater is delivered from a wastewater treatment plant to a water user, with no intervening discharge to waters of the state. Direct nonpotable reuse requires a notification to the Texas Commission on Environmental Quality (TCEQ), which is routinely accepted so long as requirements of the agency's regulations regarding direct nonpotable reuse, designed to protect public health, are met. Direct nonpotable reuse is most commonly used to supply water for landscape irrigation (especially golf courses) and industrial uses (especially cooling for steam electric power plants).

Since the *2011 Region C Water Plan*, two entities in Texas have permitted, constructed, and begun operating direct potable reuse projects: the Colorado River Municipal Water District (CRMWD) and the City of Wichita Falls.

- The CRMWD project is located in the City of Big Spring (Region F). The CRWMD Raw Water Production Plant takes treated wastewater effluent from the Big Spring Wastewater Treatment Plant, provides additional treatment with microfiltration, reverse osmosis, and ultraviolet disinfection, and produces up to 2 million gallons per day of reclaimed water. The CRWMD blends the reclaimed water with water from CRWMD reservoirs and distributes it to CRWMD member cities for conventional water treatment and use.

- In the City of Wichita Falls (Region B), treated wastewater effluent is pumped from the River Road Wastewater Treatment Plant to the Cypress Water Treatment Plant, where it is further treated through microfiltration and reverse osmosis, released into a holding lagoon, blended with lake water, treated with an eight-step conventional treatment process, stored, and pumped into the potable water distribution system. Since July 9, 2014, the project has provided up to 5 MGD, or one-third of the daily water demand in Wichita Falls.

To date, the TCEQ has handled permitting of new direct potable reuse projects on a case-by-case basis.

Indirect reuse occurs when treated wastewater is discharged to a stream or reservoir and is diverted downstream or out of a reservoir for reuse. The discharged water mixes with ambient water in the stream or reservoir as it travels to the point of diversion. Many of the water supplies within Region C have historically included return flows from treated wastewater as well as natural runoff. New indirect reuse projects may require a water right permit from the TCEQ and may also require a wastewater discharge permit from the TCEQ if the discharge location is changed as part of the reuse project. Many Region C reservoirs have water right permits in excess of firm yield, and are currently using return flows in their watersheds to provide a supplement to supply. These return flows may not be a long-term reliable supply if they are diverted for future direct reuse projects or redirected to other water bodies for future indirect reuse projects.

In general, indirect reuse strategies will require the use of multiple barriers (such as industrial pretreatment, advanced wastewater treatment, blending, residence time, monitoring, and/or advanced water treatment) to mitigate potential negative impacts to the environment, agricultural resources, and other resources. Sources of wastewater effluent needed for new reuse projects are generally limited to owners and operators of large wastewater treatment plants. These include the Trinity River Authority, which operates several wastewater treatment plants in the region, North Texas Municipal Water District, the Cities of Fort Worth and Dallas, and several smaller cities.

Potential applications for water reuse in Region C include:

- Landscape irrigation (parks, school grounds, freeway medians, golf courses, cemeteries, residential)
- Agricultural irrigation (crops, commercial nurseries)
- Industrial and power generation reuse (cooling, boiler feed, process water, heavy construction, mining)
- Recreational/environmental uses (lakes and ponds, wetlands, stream flow augmentation)
- Supplementing potable water supplies (surface and groundwater supplies)
- Direct potable reuse.

There are a number of benefits associated with water reuse as a water management strategy, including:

- Water reuse represents an effective water conservation measure.
- Water reuse provides a reliable source that remains available in a drought.
- Water reuse quantities typically increase as population increases.
- Water demands that can be met by reuse are often near reuse sources.
- Water reuse is a viable way to defer or avoid construction of new surface water supplies.

Available reuse quantities are dependent on water use, and as such are subject to reduced supplies from ongoing conservation strategies. It should also be noted that reliable reuse quantities should be based on dry-weather flows, which are likely to occur during periods of drought.

Summary of Decision: Incorporate water management strategies involving reuse as a major component of the long-term water supply for Region C. Encourage planning and implementation of additional reuse projects. Monitor legislation and regulatory actions related to reuse.

5E.5 Historical Water Use in Region C

The first step in developing effective water conservation and reuse recommendations for Region C is to understand current water use. This section discusses historical water use in Region C, describes normalization of water use data, shows Region C water use in a statewide context, reports historical reclaimed water use, and reports historical water losses.

5E.5.1 Historical Water Use in Region C and Other Parts of the State

Water use data obtained from the TWDB [9] were used to analyze historical water use in Region C. Table 5E.1 shows the summary of water use in Region C for year 2011. According to these data, 88.4 percent of the water use in Region C in the year 2011 was for municipal purposes.

Table 5E.1
TWDB Region C Summary of Water Use for Year 2011

Category	Reported Water Use (acre-feet)	Percentage of Regional Water Use
Irrigation	41,055	2.7%
Livestock	20,501	1.3%
Manufacturing	37,806	2.4%
Mining	46,249	3.0%
Municipal	1,368,076	88.4%
Steam Electric Power	34,622	2.2%
TOTAL	**1,548,309**	**100.0%**

5E.5.2 Normalized Historical Water Use Data.

Normalizing water use by the service population to obtain a per capita water use (gpcd) is often used to gain a sense of whether water is being used efficiently. The TWDB/TCEQ/WCAC *Guidance and Methodology for Reporting on Water Conservation and Water Use* [(3)] recommends calculating net municipal per capita water use by this formula:

$$\text{GPCD} = \frac{\text{(water diverted and/or purchased)} - \text{(wholesale sales + industrial sales + power sales)}}{\text{(Population of service area)} \cdot \text{(365 days)}}$$

This formula provides an estimate of municipal per capita water use that includes commercial, residential, some light industrial, and institutional water users and in some cases, municipal golf course irrigation. This definition provides a historical context for water use by a single water provider and may be a reasonable tool to assess water conservation trends over time for that provider.

The *Guidance* also recommends using total per capita water use for comparison to targets and goals. The recommended formula for total per capita water use credits indirect reuse against total diversion volumes but does not credit wholesale, industrial, or power sales:

$$\text{GPCD} = \frac{\text{(total water diverted and/or purchased)} - \text{(indirect reuse)}}{\text{(Population of service area)} \cdot \text{(365 days)}}$$

The *Guidance* does not quantify specific per capita water conservation targets or goals.

Due to local and regional differences in the factors that drive water use, the *Guidance* does not recommend comparison of municipal gpcd or total gpcd between utilities or regions. Differences in the following factors can significantly influence per capita water use of one utility relative to another:

- Composition of the customer base. Some utilities have a much greater commercial and industrial base than others, and experience greater commercial and institutional water usage than others. In addition, most of the major water users in some regions receive water from municipal providers, while in other regions, there are significant self-supplied users. (Large users tend to develop their own supplies in areas where major groundwater wells can easily be developed and in areas where substantial surface water supplies are available.)

- Climate
- Economic conditions
- Water prices
- Availability of water supplies
- Presence of an active water conservation program

Without additional data and analysis, comparison of municipal gpcd or total gpcd between utilities or regions may lead to inaccurate conclusions about comparative water use efficiencies. Instead, these quantities should be used to track water conservation progress over time for a single water provider. However, even for a single provider, if there are significant shifts in development patterns or in the percentages of commercial/institutional water use to residential use, these measurements may not accurately reflect changes in water use due to conservation practices.

For more comprehensive analysis of a utility's water use, the *Guidance* recommends dividing water use into residential, industrial, commercial, institutional, and agricultural sectors and normalizing water use in each sector by appropriate metrics. Appropriate metrics are related to factors that drive water use in each sector. Example metrics are shown in Table 5E.2. Each utility must determine appropriate metrics for its service area and water use sectors.

Very clear, consistent definitions of each water use sector and metric are required to ensure that data are comparable for each reporting entity. Utilities will likely choose different metrics to characterize their water uses. Even for residential water use, there are potential inconsistencies. For example, different utilities report multi-family usage as either residential or commercial usage, making even residential comparisons difficult. Furthermore, there is little historical data to date at this level of detail.

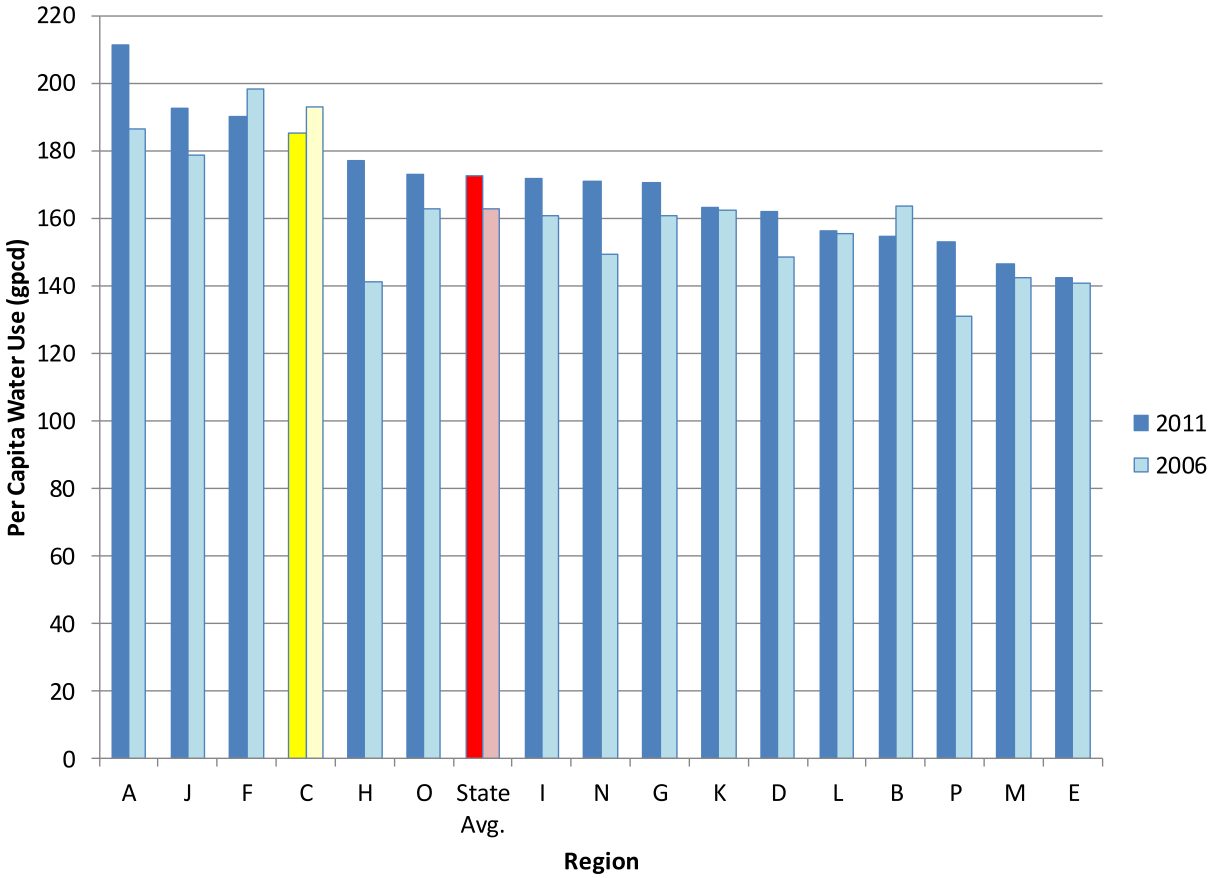
The usefulness of comparing water use between the planning regions will be increased when residential water use data are available and when uniform normalizing metrics are developed for the non-municipal sectors. However, at present, the regional data available from the TWDB only support calculation of municipal per capita water use and total per capita water use. Therefore, Figures 5E.1 and 5E.2 show the 2006 and 2011 municipal per capita water use and total per capita water use for Region C in a statewide context. These figures were developed using data reported to the TWDB from water use surveys [9]. The years 2006 and 2011 were selected for comparison because they were relatively dry years for the region.

As shown in Figure 5E.1, the year 2011 municipal per capita water use varies among the planning regions from 211 gpcd to 142 gpcd. On a per capita basis, thirteen of the sixteen regions used more water for municipal purposes in 2011 than in 2006, and three regions (B, C, and F) used less.

Table 5E.2
Example Metrics for Water Use Analysis by Sector [3]

Water Use Sector	Example Metric
Total residential	Total residential population
Single-family residential	Single-family residential population
Multi-family residential	Multi-family residential population
Industrial	Unit of production/output (e.g., tons of paper produced) Unit of input (e.g., barrels of oil refined)
Commercial	Hotels: occupied room-nights Restaurants: number of customers Retail: number of employees
Institutional	Hospitals: occupied bed-days Universities and schools: number of students Prisons: inmate population
Agricultural	Livestock: head of cattle Nursery: square foot of nursery space Crops: irrigated acres

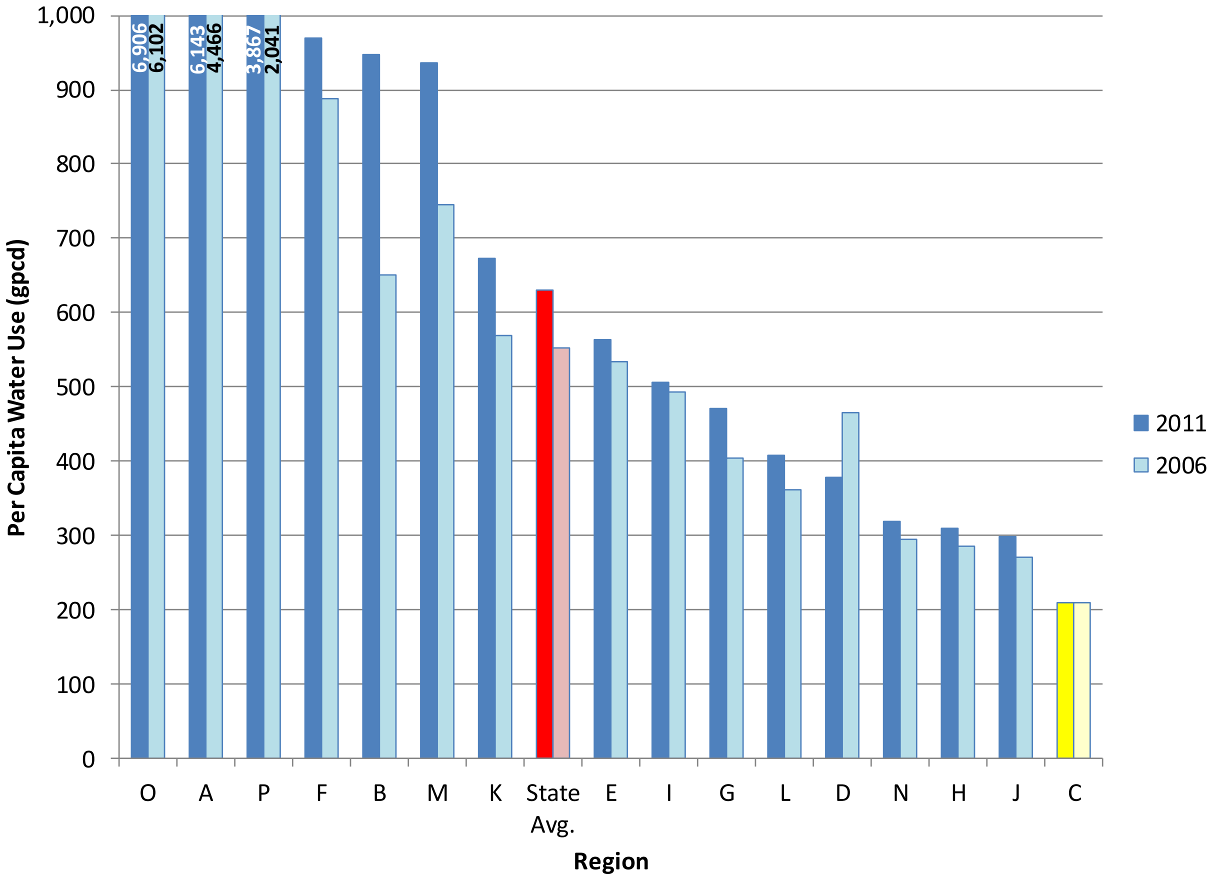
Figure 5E.1
2011 and 2006 Municipal Per Capita Water Use by Region



As shown in Figure 5E.2, the year 2011 total per capita water use in Region C is by far the lowest of any region in the state at 209 gpcd and was much lower than the statewide average of 630 gpcd. On a total per capita water use basis, fourteen of the sixteen regions used more water in 2011 than in 2006. Region D had lower total per capita water use in 2011 than in 2006, and Region C maintained the same total per capita water use.

There are several reasons for differences in per capita water use across the state, most of which have already been discussed. Some of the differences lie in the accounting of water use and the ability of some municipalities to accurately separate municipal water use from other uses that are supplied through the municipal retail provider.

Figure 5E.2
2011 and 2006 Total Per Capita Water Use by Region



Water usage data from the TWDB [10, 11, 12] were also used to compare per capita water use for several cities in Texas. Beginning in 2007, TWDB published estimates of residential per capita use in addition to municipal per capita use. Twelve major cities in Texas were selected for a comparison of historical per capita municipal water use in various parts of the state: Amarillo, Austin, Beaumont, Brownsville, Corpus Christi, Dallas (DWU), El Paso, Fort Worth, Houston, Laredo, Lubbock, and San Antonio (SAWS). The five-year trailing average was selected to dampen annual changes in water use that occur due to external factors, such as variations in weather.

Two cities had 2011 total per capita water use greater than 200 gpcd: Dallas and Beaumont. Each of these cities showed a decrease in per capita water usage from 2001 to 2006 to 2011. Brownsville currently has the lowest municipal per capita water use (138 gpcd) based on 2011 five-year trailing averages. All data presented in Table 5E.3 originated from TWDB data sources [10, 11, 12].

Table 5E.3
Per Capita Water Use in Selected Cities [10, 11, 12]
- Values in Gallons per Capita per Day (gpcd) –

City	Municipal 5yr Trailing Averages			Residential 5yr Trailing Average [g]
	2001	2006	2011	2011
Amarillo	185	227	185	106
Austin [e]	161	175	155	95
Beaumont [f]	212	209	208	128
Brownsville [d,e]	207	201	138	69
Corpus Christi [a]	181	158	169	78
DWU (Dallas) [f]	261	238	203	95
El Paso [b,c,e]	172	164	139	86
Fort Worth [c]	203	191	165	81
Houston [b,e]	155	160	143	69
Laredo [a,e]	185	175	147	85
Lubbock	185	180	140	97
San Antonio (SAWS)	144	145	140	86

(a) No data available for 2006.
(b) No data available for 2010.
(c) Residential data not available for 2007.
(d) Residential data not available for 2008.
(e) Residential data not available for 2010.
(f) Residential data not available for 2011.
(g) Residential gpcd is the estimated water use for single family and multi-family residences, expressed on a per capita (population) basis. Different systems may categorize and report residential water use differently.

Although the data presented in Table 5E.3 are based on five-year trailing averages, it should be reiterated that gpcd comparisons can be misleading when comparing between cities. With this consideration, a general trend of reduced per capita demand can still be seen in cities throughout different regions in Texas.

The residential per capita water use estimates better represent population-dependent demands. Based on the period from 2007 to 2011, residential water demands for the cities in this data set range from a low of 46 percent of municipal demand (Corpus Christi) to a high of 69 percent (Lubbock), with an average of 53 percent. Residential per capita water use ranges from 69 gpcd (Brownsville and Houston) to 128 gpcd (Beaumont). Of the 12 cities in Table 5E.3, the two Region C cities, Fort Worth and Dallas, have the fourth- and eighth-lowest 2007-2011 average residential per capita water use, respectively.

5E.5.3 Historical Reclaimed Water Use in Region C

In August 2012, a survey of Chapter 210 reuse providers and indirect reuse providers in Region C was conducted to identify historical reclaimed water use. In addition, the TWDB contracted for a survey of direct and indirect reclaimed water users, reporting historical reclaimed water use from 2005 through 2010 [13, 14]. The resulting data for Region C are summarized in Table 5E.4.

Direct reuse systems that replace potable water result in immediate reductions in per capita potable water usage. The higher levels of reclaimed water usage experienced during drought periods also further aid in offsetting water supply requirements during these critical periods. The *2011 Region C Water Plan* estimated that the direct reuse projects included in Table 5E.4 would collectively provide 25,184 acre-feet per year of water by the year 2010. The *2016 Initially Prepared Region C Water Plan* estimates that the direct reuse projects included in Table 5E.4 will collectively provide 25,209 acre-feet per year of water by the year 2020. Over the course of the period evaluated here (2007 to 2011), these projects collectively provided approximately 10,000 to 14,000 acre-feet per year.

The *2011 Region C Water Plan* estimated that the indirect reuse projects included in Table 5E.4 would collectively provide 124,613 acre-feet per year of water by the year 2010. The *2016 Initially Prepared Region C Water Plan* estimates that the indirect reuse projects included in Table 5E.4 will collectively be able to provide 202,818 acre-feet per year of water by the year 2020. Over the course of the period evaluated here (2007 to 2011), these projects collectively provided approximately 52,000 to 96,000 acre-feet per year.

The primary obstacles hindering the growth of direct reuse systems in Region C are the initial capital costs required to build the necessary infrastructure and securing new customers. The primary obstacles hindering the growth of indirect reuse systems in Region C are the acquisition or amendment of water rights and development of reclaimed water conveyance systems, particularly within very urbanized areas. In order to continue advancing reuse systems within the region, continued emphasis will need to be placed on identifying means for financing these systems.

5E.5.4 Historical Water Loss in Region C

Since 2003, retail public water utilities have been required to complete and submit a water loss audit form to the TWDB every five years. The second round of water loss audit reports were submitted to the TWDB by May 1, 2011. The TWDB compiled the data from these reports [15]. The water audit reporting requirements follow the International Water Association (IWA) and American Water Works Association (AWWA) Water Loss Control Committee methodology.

Table 5E.4
Reported Historical Reclaimed Water Reuse in Region C

Sponsor	Project/Receiving Water	Use	2010 Estimate (2011 Plan) (ac-ft/yr)	2020 Estimate (2016 Plan) (ac-ft/yr)	Reported Reclaimed Water Use (ac-ft/yr)				
					2007	2008	2009	2010	2011
Direct Reuse									
Azle	Cross Timbers Golf Course	Irrigation	300	300	32	63	57	283	199
Crandall	Creekview Golf Club	Irrigation	484	455	n/a	n/a	149	120	n/a
Dallas	Cedar Crest Golf Course	Irrigation	561	561	166	138	187	190	255
Denton	Garland Power & Light	Cooling water	1,233	646	173	108	114	67	19
	Oakmont Country Club	Irrigation		455	119	215	127	191	297
	Denton Regional Medical Center	Irrigation			44	37	29	33	42
	Denton Landfill	Dust control			28	16	15	21	37
	Other	Multiple			10	15	12	18	17
Ennis	Suez Energy Generation	Cooling water	800	909	861	572	587	629	819
Fort Worth	Waterchase Golf Course	Irrigation	897	897	305	449	319	358	453
Gainesville	Keneteso Park	Irrigation	9	9	4	4	5	4	1
Garland	Forney - NextEra Energy	Cooling water	8,979	8,979	7,999	7,893	7,341	6,671	8,378
Lewisville	UTRWD/Denton County FWSD #1A – Castle Hills Golf Course	Irrigation	897	897	211	258	230	295	421
NTMWD	Stewart Creek West WWTP/Frisco	Irrigation	307	307	50	72	103	121	89
	Buffalo Creek WWTP	Irrigation	672	672	146	159	119	210	279
	Rowlett Creek WWTP	Irrigation	1,540	1,540	140	222	150	208	508
The Colony	Stonebriar Country Club	Irrigation	380	457	180	221	233	241	457
TRA	DCURD – Las Colinas	Multiple	8,000	8,000	227	1,723	961	177	1,743
	Ten Mile Creek WWTP/South Creek Ranch	Irrigation	125	125	13	36	32	28	65
Direct Reuse Subtotal			***25,184***	***25,209***	***10,708***	***12,201***	***10,770***	***9,865***	***14,079***

Table 5E.4 (continued)

Sponsor	Project/Receiving Water	Use	2010 Estimate (2011 Plan) (ac-ft/yr)	2020 Estimate (2016 Plan) (ac-ft/yr)	Reported Reclaimed Water Use (ac-ft/yr)				
					2007	**2008**	**2009**	**2010**	**2011**
Indirect Reuse									
Athens MWA	Fish Hatchery	Fish hatchery	2,872	2,872	3,848	4,342	4,519	3,725	4,774
DCPCMUD	Grapevine WWTP/Lake Grapevine	Municipal	3,317	3,311	3,925	3,839	3,854	3,852	2,894
NTMWD	Wilson Creek WWTP/Lake Lavon	Municipal	50,000	60,941	48,052	41,077	46,751	42,836	41,330
	East Fork Water Supply Project/Lake Lavon	Municipal	51,790	67,148	--	--	25,881	28,135	43,796
TRWD	Richland-Chambers Reservoir	Municipal	10,000	63,000	--	--	2,892	n/a	n/a
UTRWD	Various WWTPs/Lewisville Lake	Municipal	6,634	5,546	2,098	3,568	3,607	4,969	2,964
Indirect Reuse Subtotal			***124,613***	***202,818***	***57,923***	***52,826***	***87,504***	***83,517***	***95,758***
TOTAL DIRECT AND INDIRECT REUSE			**149,797**	**228,027**	**68,631**	**65,027**	**98,274**	**93,382**	**109,837**

NOTES:

1. Plan estimates are based on the full available supply during drought-of-record conditions. Reported reclaimed water use reflects actual demands and actual weather conditions. 2020 estimates for the *2016 Initially Prepared Region C Water Plan* are presented in Section 5E.7.
2. "--" means that the project was not operational during the specified year.
3. "n/a" means no data were reported for the project.

The primary purposes of a water loss audit are to account for all of the water being used and to identify potential areas where water can be saved. Water audits track multiple sources of water loss that are commonly described as apparent loss and real loss. Apparent loss is water that was used but for which the utility did not receive compensation. Apparent losses are associated with customer meters under-registering, billing adjustment and waivers, and unauthorized consumption. Real loss is water that was physically lost from the system before it could be used, including main breaks and leaks, customer service line breaks and leaks, and storage overflows. The sum of the apparent loss and the real loss make up the total water loss for a utility.

In Region C, 232 public water suppliers submitted a water loss audit to TWDB for 2010. These water suppliers represent a retail service population of approximately 5.76 million, or about 89 percent of the regional population. Table 5E.5 shows a summary of reported 2010 water loss accounting for Region C.

On a regional basis, the percentage of total water loss for Region C was 16.8 percent [(15)]. Extrapolating water normalization guidelines [(16)] from individual utilities to entire regions, apparent losses should be normalized by the number of service connections, and real losses for regions with 32 or more service connections per mile of main should also be normalized by the number of service connections. Based on the 2010 water loss data, Region C is performing better than the state average for apparent water loss (Figure 5E.3) and real water loss for regions with a high connection density (Figure 5E.4). However, enhanced water loss control programs are still a potentially feasible water conservation strategy for Region C WUGs.

5E.6 Existing Water Conservation and Reuse in Region C

The next step in developing effective water conservation and reuse recommendations for Region C is to understand the current level of water conservation implementation. This section discusses existing water conservation measures and reuse projects in Region C.

5E.6.1 Existing Water Conservation in Region C

A survey of all water suppliers, meetings with selected water suppliers, and water conservation plans from water suppliers were used to determine what water conservation and reuse strategies are currently being practiced in Region C. The survey asked whether a WUG has implemented or would implement the following measures as water conservation strategies or drought management strategies:

Table 5E.5
Reported 2010 Water Loss Accounting in Region C

System Input Volume 392,580,564,627 100.0%	Authorized Consumption 326,476,322,050 83.2%	Billed Consumption 311,207,662,567 79.3%	Billed Metered 311,160,353,013 79.3%	Revenue Water 311,207,662,567 79.3%
			Billed Unmetered 47,309,554 0.0%	
		Unbilled Consumption 15,268,659,483 3.9%	Unbilled Metered 6,075,590,210 1.5%	Non-Revenue Water 81,372,902,060 20.7%
			Unbilled Unmetered 9,193,069,273 2.3%	
	Water Loss 66,104,242,577 16.8%	Apparent Loss 7,524,195,587 1.9%	Unauthorized Consumption 931,036,354 0.2%	
			Customer Meter Accuracy Loss 6,327,964,160 1.6%	
			Systematic Data Handling Discrepancy 265,195,073 0.1%	
		Real Loss 58,590,770,330 14.9%	Reported Breaks and Leaks 10,937,816,083 2.8%	
			Unreported Loss 47,872,336,738 12.2%	

From (15). Water volumes shown in gallons.

Figure 5E.3

Reported 2010 Apparent Losses by Region

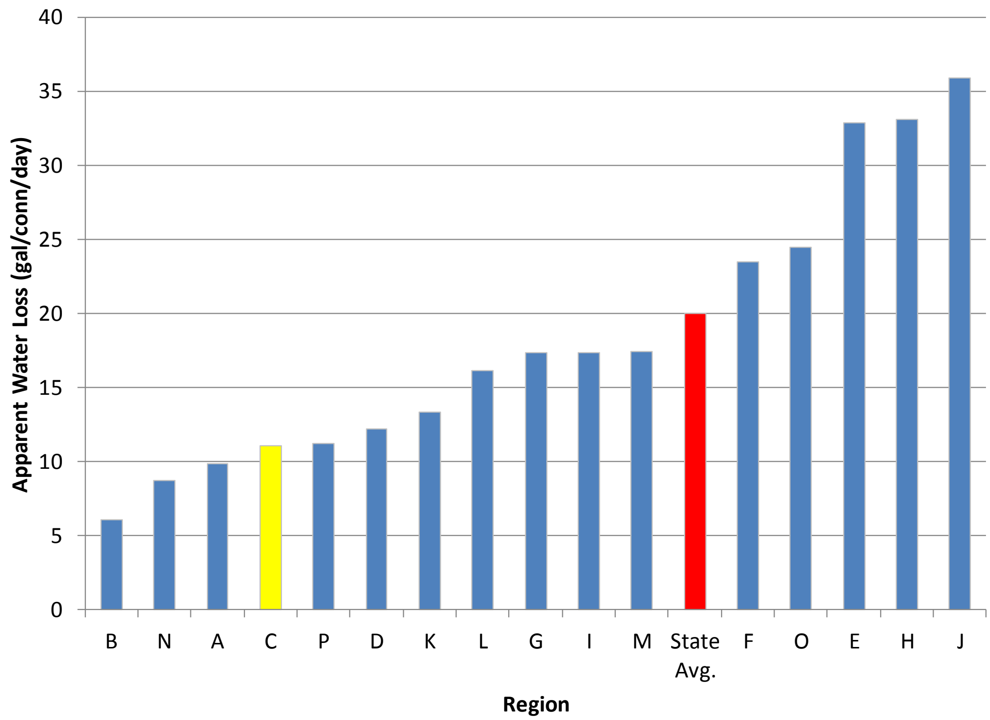
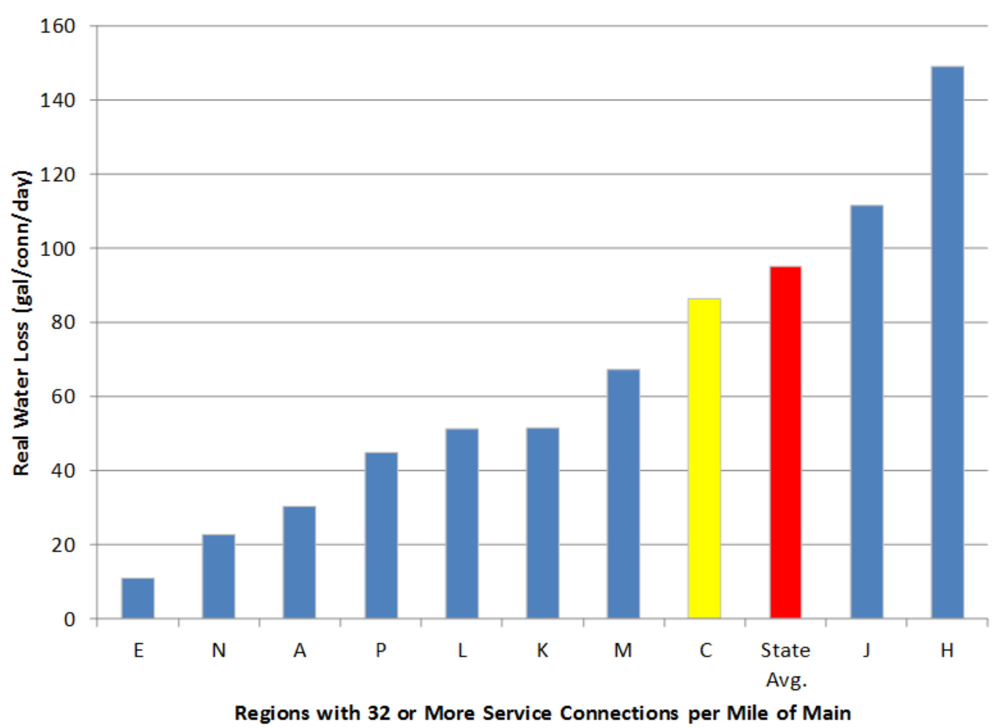


Figure 5E.4

Reported 2010 Real Losses in Regions with High Connection Density



- Public and school education;
- Increasing water prices;
- Water system audit, leak detection and repair, and pressure control;
- Water conservation pricing structure;
- Water waste prohibition;
- Time-of-day watering restrictions;
- Days per week watering restrictions;
- Coin-operated clothes washer;
- Residential customer water audit;
- Industrial, commercial, and institutional general rebate;
- Industrial, commercial, and institutional water audit, water waste reduction, and site-specific conservation program;
- Reuse of treated wastewater effluent; or
- Other measures.

On March 25, 2013, this survey was sent to 30 wholesale water providers (WWPs) and the 238 water user groups (WUGs) in Region C. Survey responses were received from 21 WWPs and 127 WUGs. Two WUGs indicated that they were not involved in water supply activities and could not provide any data. Overall, the survey had a 55 percent response rate, with 70 percent of the WWPs and 53 percent of the WUGs responding. To encourage the water providers to respond to this survey, entities who had not responded by the requested due date were contacted by phone and offered assistance.

Table 5E.6 summarizes the data collected from the surveys. Days per week watering restrictions were reported as a currently implemented water conservation measure by 35 percent of the survey respondents. However, most of these responses could not be confirmed from the entities' web sites or water conservation plans. At the time the survey was taken, many entities were subject to days per week watering restrictions as part of a drought contingency plan. Therefore, it appears that many of the positive responses may have resulted from confusion between permanent water conservation measures and temporary drought contingency measures.

The most widely implemented water conservation strategies in Region C are water system audits, leak detection and repair; time-of-day watering restrictions; and education programs.

Table 5E.6
Water Conservation Response Data from Water Retailers

Public and school education	Increasing water prices	Water system audit, leak detection and repair, and pressure control	Water conservation pricing structure	Water waste prohibition	Time-of-day watering restrictions	Days per week watering restrictions	Coin-operated clothes washer rebate	Residential customer water audit	Industrial, commercial and institutional general rebate	ICI water audit, water waste reduction, and site-specific conservation program	Reuse of treated wastewater effluent	Other
Have implemented as a current conservation strategy (% of entities responding to the survey):												
36%	30%	48%	33%	25%	43%	35%	0%	11%	1%	3%	11%	4%
Would implement as a conservation strategy in the future (% of remaining respondents):												
16%	14%	5%	12%	11%	14%	14%	4%	15%	6%	12%	9%	0%

Based on the survey responses and the historical water use data presented in Section 5E.5, significant efforts have been made by water providers and water users to conserve water in Region C. Regional coordination is one tool that has been utilized by wholesale water providers in the region. The North Texas Municipal Water District, Dallas Water Utilities, and Tarrant Regional Water District jointly sponsor the annual North Texas Regional Water Conservation Symposium. Outdoor water conservation practices, such as time-of-day watering restrictions, have become part of local ordinances in Fort Worth, Dallas, and most of the larger cities in the area. Cities and water utilities have begun allocating conservation staff and budgeting dollars as part of their permanent water management strategies. These individual conservation efforts are part of the ongoing Region C effort to promote conservation as a permanent, valuable water management strategy.

The projected municipal water demand (Chapter 2) includes water conservation savings achieved by Region C WUGs through 2011. Although the savings have not been quantified on a regional basis, Region C WUGs have achieved a substantial amount of water savings. For example, the projected 2000 per capita water demands from the *2001 Region C Water Plan* [17] were 260 gpcd for Dallas and 230 gpcd for Fort Worth. The current estimated “dry year base” per capita demands for Dallas and Fort Worth are 207 gpcd and 185 gpcd, respectively. Therefore, based on these numbers and 2011 population estimates obtained from the Texas State Data Center, realized water savings of more than 110,000 acre-feet per year are built into the water demand projections for these two cities alone.

5E.6.2 Existing Reuse Projects

Reuse of treated wastewater effluent has been a source of water supply in Region C for a number of years. Table 5E.7 lists currently operating reuse projects in Region C and the amount that can be used with existing infrastructure and current users (for direct reuse). Based on existing permitted reuse projects, Region C is expected to have more than 283,000 acre-feet per year of wastewater return flows available for use as water supplies in 2020. Under current permits and infrastructure, this existing supply is expected to increase to more than 427,000 acre-feet per year by 2070.

There are also several reuse projects that are permitted but that do not have infrastructure to utilize this water. Others are not fully utilized due to infrastructure limitations. Development of the infrastructure for these projects is considered a water management strategy. Further discussion of current reuse projects is included in Appendix I.

Significant new reuse projects since the last plan include:

- The City of Dallas has expanded its direct non-potable reuse system to serve Stevens Park Golf Course.
- The City of Fort Worth's Village Creek Reclaimed Water Delivery System was constructed and now serves the Cities of Arlington and Euless and the Dallas-Fort Worth International Airport.
- TRWD has expanded the George W. Shannon Wetlands Water Reuse Project, which diverts return flows into off-channel, wetland impoundments for water quality treatment purposes before delivery into Richland-Chambers Reservoir for storage and diversion, to its full capacity.

5E.7 Recommended Water Conservation and Reuse in Region C

Water conservation has been a major component of the previous Region C Water Plans. According to *2012 Water for Texas* [18], the current state water plan, Region C will be responsible for 44 percent of the recommended municipal water conservation in the state by 2060. The Region C Water Planning Group continues to place strong emphasis on water conservation and reuse as a means of meeting projected water needs in the region. After a discussion of conservation requirements for interbasin transfers of water, this section discusses new recommendations for water conservation and reuse strategies in Region C.

Table 5E.7
Existing Reuse Projects in Region C
- Values in Acre-Feet per Year –

Provider	Project Name	Type	County [(a)]	2020	2030	2040	2050	2060	2070
Annetta	Annetta Reuse	Direct	Parker	95	95	95	95	95	95
Azle	Cross Timbers Golf Course	direct	Tarrant	300	300	300	300	300	300
Bryson	Jack County Reuse	direct	Jack	27	26	26	25	25	24
Country Club WSC	Country Club WSC Reuse	direct	Kaufman	92	92	92	92	92	92
Crandall	Crandall Reuse	direct	Kaufman	455	558	666	666	666	666
DWU	Cedar Crest Golf Course Reuse	direct	Dallas	561	561	561	561	561	561
DWU	Stevens Park Golf Course Reuse	direct	Dallas	560	560	560	560	560	560
DWU	Indirect Reuse	indirect	Denton	32,550	38,223	41,048	55,000	73,091	87,511
DCPCMUD	City of Grapevine Reuse	indirect	Tarrant	3,311	3,677	3,716	3,701	3,698	3,698
Denton	Denton Steam Electric Power Direct Reuse	direct	Denton	646	836	1,051	1,328	1,818	2,216
Denton	Denton Other Direct Reuse	direct	Denton	455	503	556	614	678	749
Denton	Denton Indirect Reuse	indirect	Denton	6,775	8,729	10,922	12,953	12,818	12,683
Denton County FWSD#1/ UTRWD/Lewisville	Castle Hills Golf Course Reuse	direct	Denton	897	897	897	897	897	897
Ennis	Suez Energy Generation Power Plant Reuse	direct	Ellis	909	909	909	909	909	909
Fort Worth	Village Creek Reclaimed Water Delivery System	direct	Tarrant	3,469	3,526	3,526	3,526	3,526	3,526
Fort Worth	Waterchase Golf Course Reuse	direct	Tarrant	897	897	897	897	897	897
Gainesville	Keneteso Park Reuse	direct	Cooke	9	9	9	9	9	9
Garland/Forney	Forney - Next Era Energy Reuse	direct	Kaufman	8,979	8,979	8,979	8,979	8,979	8,979

(a) County reflects the location of reuse project.

Table 5E.7 (continued)

Provider	Project Name	Type	County [a]	2020	2030	2040	2050	2060	2070
Millsap WWTP	Millsap ISD Reuse	direct	Parker	2	2	2	2	2	2
NTMWD	Rowlett Creek Reuse	direct	Collin	1,540	1,540	1,540	1,540	1,540	1,540
NTMWD	Buffalo Creek Reuse	direct	Rockwall	672	672	672	672	672	672
NTMWD	Wilson Creek Reuse	indirect	Collin	47,418	56,386	63,785	71,882	71,882	71,882
NTMWD	East Fork Reuse	indirect	Kaufman	47,802	62,977	75,524	87,291	97,655	100,890
NTMWD/Frisco	Stewart Creek West Reuse	direct	Collin	307	307	307	307	307	307
Pinnacle Club	Pinnacle Club Reuse	direct	Henderson	32	32	32	32	32	32
TRWD	Richland Chambers Reservoir Reuse Project	indirect	Navarro	100,465	100,465	100,465	100,465	100,465	100,465
The Colony	Stonebriar Country Club Reuse	direct	Collin	457	457	457	457	457	457
TRA	Ten Mile Creek WWTP Reuse	direct	Dallas	125	125	125	125	125	125
TRA	TRA/Waxahachie Reuse	indirect	Ellis	3,479	3,882	4,614	5,129	5,129	5,129
TRA/DCURD	Las Colinas Reuse	direct/ indirect	Dallas	8,000	8,000	8,000	8,000	8,000	8,000
Trophy Club	Denton County Golf Reuse	direct	Denton	800	800	800	800	800	800
UTRWD	Lake Chapman Indirect Reuse	indirect	Denton	5,546	5,689	5,832	5,976	6,119	6,262
Wise County	Wise County Mining Reuse	direct	Wise	6,261	6,261	6,261	6,261	6,076	6,076
TOTAL				**283,893**	**316,972**	**343,226**	**380,051**	**408,880**	**427,011**

(a) County reflects the location of reuse project.

5E.7.1 Conservation Requirements for Interbasin Transfers of Water

Recommended water management strategies for many WUGs in Region C include a new interbasin transfer of surface water. Section 11.085 of the Texas Water Code includes permitting requirements for such interbasin transfers. Section 11.085(l)(2) defines the conservation standard for interbasin transfers, indicating that the Texas Commission on Environmental Quality (TCEQ) may grant a water right "to the extent that…the applicant for the interbasin transfer has prepared a drought contingency plan and has developed and implemented a water conservation plan that will result in the highest practicable levels of water conservation and efficiency achievable within the jurisdiction of the applicant."

Section 11.1271(e) of the Water Code indicates that the TWDB and the TCEQ should jointly "develop model water conservation programs for different types of water suppliers that suggest best management practices for achieving the highest practicable levels of water conservation and efficiency achievable for each specific type of water supplier." The TWDB and the TCEQ have addressed this requirement by preparing TWDB Report 362, the *Water Conservation Best Management Practices Guide* (7). The TWDB, the TCEQ, and the WCAC have been working to update these BMPs (19).

5E.7.2 Recommended Conservation Strategies for Region C

For this report, the Region C Water Planning Group analyzed the applicability and appropriateness in Region C of the Best Management Practices suggested in the *Guide*, considering cost, potential water savings, and opportunities for implementation and taking into account the current implementation levels indicated in the water conservation survey (described in Section 5E.6). Based on this analysis, the region recommends a Water Conservation Package that reflects practices that are:

- Practicable for implementation in Region C,
- Projected to provide long-term water savings, and
- Projected to provide a reasonable quantity of water savings at a reasonable cost for a wide range of water user groups.

The Water Conservation Package is recommended for implementation by <u>each municipal water user group in the region</u>. The Water Conservation Package includes:

- Low flow plumbing fixture rules (required by state and federal law),
- Efficient new residential clothes washer standards,
- Efficient new residential dishwasher standards (new in *2016 Initially Prepared Region C Water Plan*),

- Enhanced public and school education,
- Price elasticity/rate structure impacts,
- Enhanced water loss control program,[1]
- Time-of-day irrigation restriction, and
- Water waste prohibition.

The first three water conservation practices included in the Water Conservation Package are state- and/or federally-mandated initiatives that will reduce water use over time simply through the natural replacement of high water use fixtures and appliances.

- The first initiative is the Water Saving Performance Standards for Plumbing Act, implemented by Texas in 1992. This act prohibits the sale, distribution, or importation of plumbing fixtures that do not meet certain low flow performance standards. The "low flow plumbing fixture rules" measure assumes that all new construction will be built with water saving plumbing fixtures and that existing plumbing fixtures will be replaced over time with low flow fixtures. House Bill 2667, implemented September 1, 2009, updated the water savings performance standards. For new fixtures, the average toilet flush volume is limited to 1.28 gallons, and the maximum showerhead flow is limited to 2.5 gallons per minute.
- The second initiative is a federal requirement that residential clothes washers manufactured on or after January 1, 2007, must achieve a water factor[2] of 9.5 gallons per cubic foot of capacity. For front-loading machines, the maximum integrated water factor[3] decreases to 4.5 gallons per cubic foot on March 7, 2015. For top-loading machines, the maximum integrated water factor decreases to 8.4 gallons per cubic foot on March 7, 2015, and 6.5 gallons per cubic foot on January 1, 2018.
- The third initiative is a federal requirement that residential dishwashers manufactured on or after May 30, 2013, must achieve water consumption of 5 gallons per cycle or less. The "efficient new residential clothes washer standards" and "efficient new residential dishwasher standards" measures assume that all new construction will be built with efficient clothes washers and dishwashers and that existing clothes washers and dishwashers will be replaced over time with efficient appliances.

The three state- and/or federally-mandated initiatives are projected to produce significant water conservation savings, and the Region C Water Planning Group has built these savings into its water demand projections. The projected 2070 municipal water demand in Region C is about 8.7 percent less than it would be without this "built-in" water conservation.

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[1] An enhanced water loss control program may include comprehensive water loss audits, active leak detection and repair, pressure control, replacement of water mains that are a significant source of water loss, implementation/installation of automatic meter reading (AMR) technology, implementation/installation of an advanced meter infrastructure (AMI) system to significantly reduce water loss, or other measures deemed appropriate to prevent or reduce water loss.
[2] Total weighted per-cycle water consumption for the cold wash/cold rinse cycle divided by the clothes container capacity.
[3] Total weighted per-cycle water consumption for all wash cycles divided by the clothes container capacity.

The remaining measures in the Water Conservation Package are recommended for implementation by each municipal water user group in the region that meets the following eligibility criteria:

- The projected water demand is greater than the existing water supply.
- The projected total water demand is greater than 140 gpcd. The 140 gpcd goal was introduced as a recommended total gpcd utility goal by the Water Conservation Implementation Task Force [20] and utilized as a threshold for recommendation of conservation measures in the *2016 Initially Prepared Region C Water Plan*. This is a suggested goal and not a planning or regulatory requirement.
- The measure is not already implemented (if already implemented, the savings are already included in the demand projections), and the measure is applicable to the WUG.
- A sponsor can be identified to implement the water conservation measure.

The cost of water from the measure is less than $5.00 per thousand gallons.

The development of the recommended Water Conservation Package included several assumptions related to measure adoption rates and realization of full benefits over time. For most measures it was assumed that full benefits would be realized by 2030. Methods for estimating costs and water savings for the Water Conservation Package are described in Appendix K. Dallas Water Utilities provided its own water conservation water savings and cost estimates.

General rebates are the recommended non-municipal conservation strategies associated with irrigation and manufacturing demands. It is anticipated that municipal WUGs would offer rebates for golf course and manufacturing water conservation measures implemented within their service areas. General rebates have been recommended for irrigation and manufacturing WUGs that meet the eligibility criteria described above for municipal WUGs.

For WUGs that are projected to receive water in the future from a new interbasin transfer, the water savings associated with the recommended municipal and non-municipal water conservation strategies represent the highest practicable level of water conservation and efficiency achievable in the region. With respect to projected water savings and costs, the Water Conservation Package is expected to have similar reliability to the other recommended water management strategies in the plan.

5E.7.3 Recommended Reuse Projects in Region C

Discussions with the regional and local water providers identified several potential reuse projects that could be used to help meet the projected shortages in Region C. Table 5E.8 lists recommended reuse strategies for Region C. A total of 24 reuse projects are recommended with a cumulative 2070 supply amount of 355,118 acre-feet per year. More detailed descriptions of the recommended reuse projects are included in Appendix P.

5E.7.4 Summary of Recommended Water Conservation and Reuse in Region C

Cities and utilities in Region C have made significant strides in the implementation of water conservation efforts in Region C. It is important that suppliers in the region build on this momentum with continued conservation efforts, and this plan suggests areas of emphasis for that effort. Table 5E.9 shows a regional summary of estimated water savings from recommended water conservation and reuse strategies. It also shows the amount of conservation that is included in the approved water demands for the region. The projected 2070 Region C water demand with no conservation is 2,841,702 acre-feet per year (this amount includes the TWDB-approved 2070 demand value plus 246,869 acre-feet per year of conservation from low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards). The existing and recommended 2070 water conservation and reuse strategies, including those that are assumed in the demands, will meet almost 1.2 million acre-feet per year (or 41.0 percent) of the pre-conservation demand. Estimated costs for these strategies by entity are included in Appendix Q. The recommended water conservation for each water user group is shown in Appendix C.

5E.7.5 Other Recommendations

Although specific water conservation measures (or BMPs) are identified as part of the Water Conservation Package, these are suggested methods to achieve the projected water savings. However, WUGs and WWPs should not be restricted to these specific measures in their approach to achieving the projected water savings associated with the Water Conservation Package. The recommended measures were studied at a regional level, and more detailed studies conducted for individual suppliers may indicate that some of these measures are not practicable for individual suppliers or that alternate measures should be implemented. Each WUG and WWP should tailor its water conservation implementation to its particular service area characteristics, considering not only the measures in the Water Conservation Package but other potential measures, including other BMPs recommended by the TWDB [19]. Therefore, any water conservation method that is proven to result in reduced demand for potable water should be considered as consistent with the regional water plan for funding and permitting purposes.

Table 5E.8
Recommended Reuse Projects in Region C*
- Values in Acre-Feet per Year -

Provider	Project Name	Type	County [a]	2020	2030	2040	2050	2060	2070
Athens MWA	Athens Fish Hatchery	indirect	Henderson	2,872	2,872	2,872	2,872	2,872	2,872
Cooke County	Direct Reuse	direct	Cooke	70	70	70	70	70	70
Cooke County Mining	Mining Reuse	direct	Cooke	99	67	71	74	77	80
DWU	DWU Main Stem Pump Station	indirect	Dallas	34,751	34,751	34,751	34,751	34,751	34,751
DWU	Ellis County Off-Channel	Indirect	Ellis	0	0	0	84,075	102,011	114,342
Ennis	Indirect Reuse	indirect	Ellis	0	0	2,034	2,969	3,696	3,696
Fort Worth	Fort Worth Future Direct Reuse	direct	Tarrant	2,688	6,934	8,166	8,166	8,166	8,166
Frisco	Collin/Denton County Direct Reuse	direct	Collin/Denton	2,240	3,360	5,650	5,650	5,650	5,650
Jacksboro	Indirect Reuse (Jack County mining)	indirect	Jack	330	342	348	351	356	359
Irving/TRA	Irving Direct for Municipal Use	Indirect	Dallas	28,025	28,025	28,025	28,025	28,025	28,025
NTMWD/TRA	Central Reuse for East Fork Wetlands	Indirect	Dallas/Kaufman	53,088	37,913	25,366	13,599	3,235	0
Tarrant County SEP	Tarrant County SEP	direct	Tarrant	0	1,528	2,360	2,360	2,360	2,360
TRA	Alliance Corridor Direct Reuse	Direct	Tarrant/Denton	3,921	3,921	11,537	11,537	11,537	11,537
TRA	Dallas County Indirect Reuse	indirect	Dallas	0	5,000	6,750	6,750	6,750	6,750
TRA	Joe Pool Lake Indirect Reuse	indirect	Dallas	1,914	2,835	4,041	4,368	4,368	4,368

* NOTE: Lists recommended reuse strategies for Region C and does not include existing reuse projects.
(a) County reflects location of reuse project.

Table 5E.8* (continued)

Provider	Project Name	Type	County [(a)]	2020	2030	2040	2050	2060	2070
TRA	Ellis County Direct Reuse	direct	Ellis	0	0	0	0	2,200	4,700
TRA	Freestone County Indirect Reuse	indirect	Freestone	0	0	0	6,760	6,760	6,760
TRA	Kaufman County Indirect Reuse	indirect	Kaufman	1,000	1,000	1,000	1,000	1,000	1,000
TRA	Additional Las Colinas Direct Reuse	direct	Dallas	7,000	7,000	7,000	7,000	7,000	7,000
TRWD	Trinity River Indirect Reuse - Cedar Creek	indirect	Henderson /Kaufman	0	37,163	63,204	82,860	88,059	88,059
UTRWD	Indirect Reuse of Lake Ralph Hall Water	indirect	Fannin	4,744	9,733	14,967	15,335	15,703	16,071
UTRWD	Direct Reuse	direct	Denton	0	560	1,121	2,240	2,240	2,240
Weatherford	Lake Weatherford Indirect Reuse	indirect	Parker	2,240	2,240	2,240	2,240	2,240	2,240
Wise County Mining Reuse	Wise County Mining Reuse	direct	Wise	0	0	87	1,234	2,401	4,022
Total				**144,982**	**185,314**	**211,660**	**324,286**	**341,527**	**355,118**

* NOTE: Lists recommended reuse strategies for Region C and does not include existing reuse projects.
(a) County reflects location of reuse project.

Table 5E.9
Summary of Existing and Recommended Conservation (Including Reuse) for Region C
- Values in Acre-Feet per Year –

Strategy	2020	2030	2040	2050	2060	2070
Municipal Conservation						
State/federal initiatives[a]	73,851	117,317	157,079	190,552	218,797	246,869
Municipal Recommended Conservation	55,532	88,085	96,213	108,956	120,028	131,108
Non-Municipal Conservation						
Non-Municipal conservation strategies[b]	34	731	2,936	4,053	4,488	4,884
Reuse Strategies						
Existing Reuse	283,893	316,972	343,226	380,051	408,880	427,011
Recommended Reuse Strategies	144,982	185,314	221,660	324,286	341,527	355,118
Total Conservation and Reuse	558,292	708,419	821,114	1,007,898	1,093,720	1,164,990
Total Region C Municipal Demand[c]	1,481,530	1,675,385	1,894,722	2,119,813	2,352,818	2,594,833
Total Municipal Demand without Conservation	1,555,381	1,792,702	2,051,801	2,310,365	2,571,615	2,841,702
Total Conservation and Reuse	35.9%	39.5%	40.0%	43.6%	42.5%	41.0%

a. State/federal initiatives include low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards. These values provided by TWDB. For listing by County and WUG, see Appendix E, beginning on page E.195.

b. Non-municipal water conservation measures include estimated conservation savings from manufacturing and irrigation rebates.

c. Total Region C Municipal Demand includes projected conservation savings from low flow plumbing fixtures, efficient residential clothes washer standards, and efficient residential dishwasher standards. These savings were added to the Total Region C Municipal Demand to obtain the Total Municipal Demand without Conservation, a projection of Region C's demands if no conservation occurred.

5E.8 Per Capita Water Use in Region C with the Implementation of the Recommended Plan

The *Report to the 79th Legislature* [20] from the Water Conservation Implementation Task Force suggested that when establishing conservation targets and goals, a water supplier should consider "a minimum annual reduction of one percent in total gpcd, based upon a five-year rolling average, until such time as the entity achieves a total gpcd of 140 or less." The gpcd values used for Region C projections are dry year estimates, whereas the 140 gpcd recommendation is based on a five-year rolling average. The five-year average gpcd is typically 10-15% less than a dry year gpcd.

The 140 gpcd goal has no specific regulatory basis, and it may not be appropriate for all entities based on differences in climatic conditions and other water use characteristics. However, since this number has been used in previous plans and is recognized statewide, it is used to provide a baseline for comparison in the discussion below.

This section of the report compares the per capita water use that would result from implementation of the *2016 Initially Prepared Region C Water Plan* to the suggested voluntary goal of 140 gpcd.

5E.8.1 Region C Per Capita Municipal Water Use

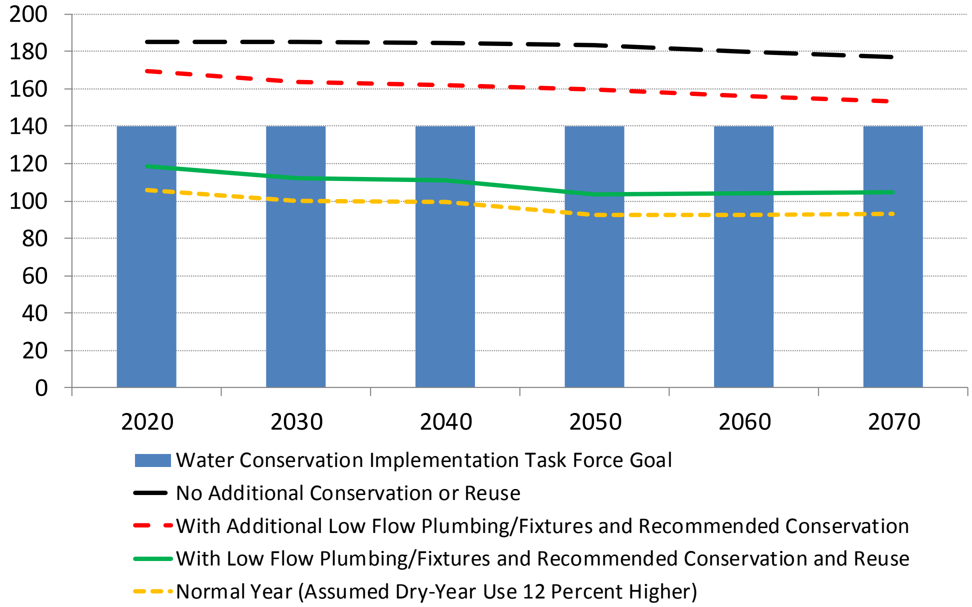
This plan recommends significant conservation efforts and the development of substantial new supplies from reuse. Table 5E.10 summarizes the projected per capita municipal water use for Region C with the implementation of the plan. Figure 5E.5 is a graph of the data from Table 5E.10. The figure and the table show the following:

- With no conservation or reuse at all, the projected dry-year per capita municipal water use in Region C is 177 gpcd in 2070.
- Implementation of the plumbing code requiring the use of low flow plumbing fixtures is expected to reduce the 2070 per capita municipal use by a total of about 16 gpcd, to 161 gpcd.
- The recommended water conservation measures in the *2016 Region C Water Plan* will reduce the projected 2070 per capita municipal use by an additional 8 gpcd, to 153 gpcd.
- The existing and recommended municipal water reuse projects will reduce the projected per capita municipal water use well under the suggested voluntary goal of 140 gpcd in each decade (Figure 5E.7). These projects will reduce the 2070 per capita municipal use by an additional 48 gpcd, to 105 gpcd.
- The projected normal year per capita use is 10-15 percent lower than dry-year use and is also well under the suggested voluntary goal of 140 gpcd.
- Many of the recommended reuse projects in this plan are proposed for implementation by 2020, leading to a rapid reduction in per capita use in Region C after crediting for reuse.

Table 5E.10
Projected Municipal Per Capita Use in Region C

	Projections					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Basic Data						
Population	7,504,200	8,648,725	9,908,572	11,260,257	12,742,283	14,347,912
Municipal Demand without Add'l Low Flow Fixtures (Acre-feet)	1,555,381	1,792,702	2,051,801	2,310,365	2,571,615	2,841,702
Municipal Demand with Add'l Low Flow Fixtures (Acre-feet)	1,481,530	1,675,385	1,894,722	2,119,813	2,352,818	2,594,833
Recommended Municipal Water Conservation (Acre-feet)	55,532	88,085	96,213	108,956	120,028	131,108
Current Municipal Reuse (Acre-feet)	283,893	316,972	343,226	380,051	408,880	427,011
Recommended Municipal Reuse (Acre-feet)	144,982	185,314	221,660	324,286	341,527	355,118
Municipal Per Capita Use (Gallons per Capita per Day)						
No Conservation or Reuse	185	185	185	183	180	177
With Full Implementation of Low Flow Fixtures	176	173	171	168	165	161
With Low Flow Fixtures and Recommended Conservation	171	164	162	159	156	153
With Recommended Conservation and Reuse	119	112	111	104	104	105
Normal-Year Use (Assumed Dry-Year Use 12 Percent Higher)	106	100	99	92	93	93

Figure 5E.5
Projected Municipal Per Capita Water Use in Region C



5E.8.2 Region C Per Capita Municipal and Manufacturing Water Use

The Water Conservation Implementation Task Force's suggested voluntary goal of 140 gpcd is based on potable water supplied to municipal retail customers. In Region C, manufacturers also use wholesale, self-supplied, and non-potable water. Therefore, the region-wide per capita use to be compared to the recommended goal of 140 gpcd will be between the region-wide per capita municipal use and the region-wide per capita municipal and manufacturing use.

Table 5E.11 summarizes the projected per capita municipal and manufacturing water use for Region C with the implementation of this plan. Figure 5E.6 is a graph of the data from Table 5E.11. The figure and the table show the following:

- With no conservation or reuse at all, the projected per capita municipal and manufacturing water use in Region C would be 184 gpcd in 2070.
- Implementation of the plumbing code requiring the use of low flow plumbing fixtures is expected to reduce the 2070 per capita use by a total of about 16 gpcd, to 168 gpcd.
- The recommended water conservation measures in the *2016 Region C Water Plan* will reduce the projected 2070 per capita municipal and manufacturing use by an additional 8 gpcd, to 160 gpcd.
- The existing and recommended water reuse projects will reduce the projected per capita municipal and manufacturing water use well under the suggested voluntary goal of 140 gpcd in each decade (Figure 5E.8). These projects will reduce the 2070 dry-year per capita municipal and manufacturing use by an additional 49 gpcd, to 111 gpcd.

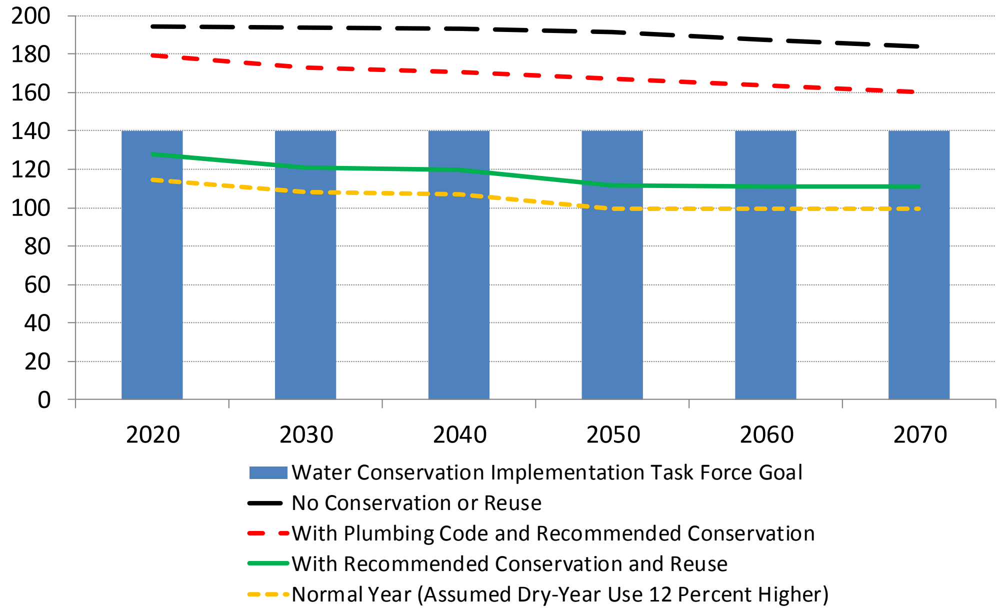
- The projected normal year per capita use is 10-15 percent lower than dry-year use and is also well under the recommended goal of 140 gpcd.

Table 5E.11
Projected Municipal and Manufacturing Per Capita Use in Region C

	Projections					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
Basic Data						
Population	7,504,200	8,648,725	9,908,572	11,260,257	12,742,283	14,347,912
Municipal Demand without Add'l Low Flow Fixtures	1,555,381	1,792,702	2,051,801	2,310,365	2,571,615	2,841,702
Municipal Demand with Add'l Low Flow Fixtures	1,481,530	1,675,385	1,894,722	2,119,813	2,352,818	2,594,833
Manufacturing Demand	79,540	87,958	96,154	103,307	107,899	112,839
Recommended Mun. and Man. Water Conservation	55,566	88,816	99,149	113,009	124,516	135,992
Current Municipal and Manufacturing Reuse	283,893	316,972	343,226	380,051	408,880	427,011
Recommended Municipal and Manufacturing Reuse	144,982	185,314	221,660	324,286	341,527	355,118
Per Capita Use (Gallons per Capita per Day)						
No Conservation or Reuse	194	194	194	191	188	184
With Full Implementation of Low Flow Fixtures	186	182	179	176	172	168
With Low Flow Fixtures and Recommended Conservation	179	173	170	167	164	160
With Recommended Conservation and Reuse	128	121	120	111	111	111
Normal-Year Use (Assumed Dry-Year Use 12 Percent Higher)	114	108	107	100	99	99

a. Manufacturing water conservation measures include estimated conservation savings from manufacturing rebates.

Figure 5E.6
Projected Municipal and Manufacturing Per Capita Water Use in Region C



5E.9 Water Conservation Policy Recommendations

The Region C Water Planning Group has made policy and legislative recommendations on the following topics related to water conservation and reuse:

- Support legislative and stage agency findings regarding water use evaluation
- More state funding for water conservation efforts
- Support research to advance reuse and desalination
- Funding assistance for desalination and water reuse projects
- Revise Federal Section 316(b) regulations on power plant cooling water

The policy and legislative recommendations are discussed in Chapter 8.

5E.10 Water Conservation Plans and Reporting Requirements

The TCEQ requires water conservation plans for all municipal, industrial, and other non-irrigation water users with surface water rights of 1,000 acre-feet per year or more, all irrigation water users with surface water rights of 10,000 acre-feet per year or more, and all retail public water suppliers providing water service to 3,300 connections or more [21]. Water conservation plans are also required for all water users applying for a new or amended state water right and for entities seeking state funding of more than

$500,000 for water supply projects. Updated water conservation plans were required to be submitted to the TCEQ and/or the TWDB by May 1, 2009, and every five years after that date [21].

Table 5E.12 lists estimated Region C entities that are required by TCEQ to develop a water conservation plan based on having 3,300 or more retail water connections, irrigation water rights of 10,000 acre-feet per year or more, and/or non-irrigation water rights of 1,000 acre-feet per year or more. Connections for each WUG were identified from the TCEQ's Water Utility Database [22], and applicable water rights were identified from TCEQ's Water Rights Database [23]. Table 5E.12 may not include Region C entities required to develop water conservation plans based on a water right application or a state funding application.

Table 5E.12
Region C Water Users Required to Develop Water Conservation Plans

Addison	Allen	Anna	Arlington
Athens	Azle	Balch Springs	Beall Concrete Enterprises Ltd
Bedford	Benbrook	Bethesda WSC	Big Brown Power Co LLC
Bolivar WSC	Bonham	Burleson	Caddo Basin SUD
Carrollton	Cash SUD	Cedar Hill	Colleyville
Coppell	Corinth	Corsicana	Crowley
Dallas	Dallas County Park Cities MUD	Dallas County WCID #6	Denison
Denton	Desoto	Duncanville	East Cedar Creek FWSD
East Fork SUD	Ellis County WCID No. 1	Ennis	Euless
Extex Laporte	Fairview	Farmers Branch	Flower Mound
Forest Hill	Forney	Fort Worth	Frisco
Gainesville	Garland	Glenn Heights	Grand Prairie
Grapevine	Greater Texoma Utility Authority	Haltom City	Hanson Aggregates Central Inc
Highland Park	Highland Village	Hurst	Irving
Jacksboro	J-M Manufacturing Co Inc	Johnson County SUD	Keller
Lafarge Corporation	Lake Cities MUA	Lancaster	Lewisville
Little Elm	Luminant Generation Co LLC	Mansfield	McKinney
Mesquite	Midlothian	Mineral Wells	Mountain Peak SUD
Murphy	Mustang SUD	North Richland Hills	North Texas Municipal Water District
Plano	Prosper	Red River Authority	Rice WSC
Richardson	Richland Hills	River Oaks	Rockett SUD
Rockwall	Rowlett	Royse City	Sachse
Saginaw	Sardis-Lone Elm WSC	Seagoville	Sherman
Southlake	Tarrant Regional Water District	Terrell	The Colony
Trinidad	Trinity River Authority	Trophy Club	TXI Operations LP

University Park	Upper Trinity Regional Water District	Valley NG Power Co LLC	Walnut Creek SUD
Watauga	Waxahachie	Weatherford	West Cedar Creek MUD
White Settlement	Wylie		

NOTE: The table shows Region C entities with 3,300 or more retail water connections, irrigation water rights of 10,000 acre-feet per year or more, and/or non-irrigation water rights of 1,000 acre-feet per year or more. It may not include Region C entities required to develop water conservation plans based on a water right application or a state funding application.

5E.10.1 Municipal Water Conservation Plan Requirements

The TCEQ requires the following minimum content in a municipal water conservation plan:

- Utility profile
- Record management system
- Specific, quantified five-year and ten-year targets for water savings
- Accurate metering
- Universal metering
- Determination and control of water loss
- Public education and information program
- Non-promotional water rate structure
- Reservoir system operation plan
- Means of implementation and enforcement
- Coordination with regional water planning group.
- Implementation report detailing progress toward implementing the water conservation plan and whether water savings targets are being met.

In addition, the TCEQ requires additional minimum content for municipal entities that are projected to supply 5,000 people or more in the following 10 years:

- Leak detection, repair, and water loss accounting
- Requirement for water conservation plans by wholesale customers.

The TCEQ also suggests optional content for municipal water conservation plans:

- Conservation-oriented water rates
- Ordinances, plumbing codes, or rules on water-conserving fixtures
- Programs for the replacement or retrofit of water-conserving plumbing fixtures in existing structures

- Reuse and recycling of wastewater and/or graywater
- Pressure control and/or reduction
- Landscape water management ordinance
- Monitoring methods
- Other conservation methods.
- Review and update of the plan.

5E.10.2 Irrigation Water Conservation Plan Requirements

The TCEQ requires the following minimum content in an irrigation water conservation plan:

- Description of the irrigation production process
- Description of the irrigation method or system and equipment
- Accurate metering
- Specific, quantified five-year and ten-year targets for water savings
- Description of water-conserving irrigation equipment and application system
- Leak detection, repair, and water-loss control
- Irrigation timing and/or measuring the amount of water applied
- Land improvements for retaining or reducing runoff and increasing the infiltration of rain and irrigation water
- Tailwater recovery and reuse
- Other conservation practices, methods, or techniques.
- Review and update of the plan.
- Implementation report detailing progress toward implementing the water conservation plan and whether water savings targets are being met.

5E.10.3 Manufacturing and Steam Electric Power Water Conservation Plan Requirements

The TCEQ requires the following minimum content in manufacturing or steam electric power water conservation plans:

- Description of water use in the production process
- Specific, quantified five-year and ten-year targets for water savings
- Accurate metering
- Leak detection, repair, and water-loss accounting
- Water use efficiency process and/or equipment upgrades
    - Other conservation practices
    - Review and update of plan.

- Implementation report detailing progress toward implementing the water conservation plan and whether water savings targets are being met.

5E.10.4 Model Water Conservation Plans

Model water conservation plans for Region C have been developed for four different water user types: municipal, irrigation, manufacturing, and steam electric power. The model water conservation plans are available online at www.regioncwater.org/2016 Region C Plan/Model Water Conservation Plans.pdf. The model plans are designed to show the content required by the TCEQ, optional content suggested by the TCEQ, and optional content suggested by the Region C Water Planning Group (e.g., potentially feasible water conservation strategies). The model plans are intended to be a template that Region C water user groups can use as a starting point and customize to develop their own situation-specific water conservation plans.

5E.10.5 Other Water Conservation Reporting Requirements

Other water conservation reporting requirements include:

- Annual reports: Each entity that is required to submit a water conservation plan to the TWDB or the TCEQ must file a report by May 1 each year on the entity's progress in implementing its water conservation plan. These reports can be submitted online using a form available from the TWDB web site. The reporting form asks for the following types of data: system information, water use accounting, water conservation programs and activities data, leak detection and water loss, program effectiveness, and drought plan implementation.
- Water loss audits: Retail public utilities that supply potable water to more than 3,300 connections or receive financial assistance from the TWDB must file a system water loss audit with the TWDB by May 1 each year. Other retail public utilities that supply potable water must file a system water loss audit with the TWDB every five years (the next due date is May 1, 2016) [24].
- Water use surveys: Each year, the TWDB surveys persons and/or entities using groundwater and surface water for municipal, industrial, power generation, or mining purposes to gather data to be used for long-term water supply planning. Entities that receive a water use survey are required to respond within 60 days. [24]

5E.11 Evaluation of Water Conservation Planning Requirements

As discussed in Section 5E.3, the TWDB planning rules [2] require consideration of water conservation for various water user groups. Table 5E.13 shows each requirement and documents that the requirements have been fulfilled.

Table 5E.13
Evaluation of Water Conservation Planning Requirements

Requirement	Evaluation	Fulfilled?
Conservation measures shall be considered by RWPGs when developing the regional plans, particularly during the process of identifying, evaluating, and recommending water management strategies. RWPs shall incorporate water conservation planning in the regional water planning area. [31 TAC 357.34(f)]	Water conservation practices were considered for each water user group. Existing water conservation plans and other water conservation planning information were considered during development of the Water Conservation Package for municipal water suppliers, as described in Section 5E.7.	Yes
RWPGs must consider water conservation practices, including potentially applicable best management practices, for each identified water need. [31 TAC 357.34(f)(2)]	Water conservation practices, including potentially applicable best management practices, were considered for each identified water need, as described in Section 5E.7.	Yes
RWPGs shall include water conservation practices for each user group to which Texas Water Code §11.1271 and §13.146 (relating to Water Conservation Plans) apply. The impact of these water conservation practices on water needs must be consistent with requirements in appropriate Commission administrative rules related to Texas Water Code §11.1271 and §13.146. [31 TAC 357.34(f)(2)(A)]	The Water Conservation Package was recommended for each municipal WUG, as described in Section 5E.7. In addition, it is recommended that municipal WUGs offer rebates for water conservation by irrigation and manufacturing WUGs. The impact of these recommendations is consistent with the water conservation plan requirements.	Yes
RWPGs shall consider water conservation practices for each WUG beyond the minimum requirements of subparagraph (A) of this paragraph, whether or not the WUG is subject to Texas Water Code §11.1271 and §13.146. If RWPGs do not adopt a water conservation strategy to meet an identified need, they shall document the reason in the RWP. [31 TAC 357.34(f)(2)(B)]	As described in Section 5E.7, water conservation practices were considered for each water user group. Where water conservation measures have not been recommended, the reason is one or more of the following conditions: 1) There is no identified water need. 2) Total demand is 140 gpcd or less. 3) The measure has already been implemented. 4) The measure is not applicable to the WUG. 5) There is not an identified sponsor that will implement the water conservation measure.	Yes

Table 5E.13 (continued)

Requirement	Evaluation	Fulfilled?
For each WUG or WWP that is to obtain water from a proposed interbasin transfer to which Texas Water Code §11.085 (relating to Interbasin Transfers) applies, RWPGs will include a water conservation strategy, pursuant to Texas Water Code §11.085(1), that will result in the highest practicable level of water conservation and efficiency achievable. For these strategies, RWPGs will determine and report projected water use savings in gallons per capita per day based on its determination of the highest practicable level of water conservation and efficiency achievable. RWPGs will develop conservation strategies based on this determination. In preparing this evaluation, RWPGs will seek the input of WUGs and WWPs as to what is the highest practicable level of conservation and efficiency achievable, in their opinion, and take that input into consideration. RWPGs will develop water conservation strategies consistent with guidance provided by the Commission in its administrative rules that implement Texas Water Code §11.085. When developing water conservation strategies, the RWPGs must consider potentially applicable best management practices. Strategy evaluation in accordance with this section will include a quantitative description of the quantity, cost, and reliability of the water estimated to be conserved under the highest practicable level of water conservation and efficiency achievable. [31 TAC 357.34(f)(2)(C)]	Water conservation strategies were included for each WUG or WWP that is to obtain water from a proposed interbasin transfer to which Texas Water Code §11.085 applies. Recommended water conservation strategies were developed based on findings from the conservation survey, analysis of existing conservation practices in the region, and best management practices. The recommendations reflect practices that are practicable for implementation in Region C, projected to provide long-term water savings, and projected to provide a reasonable quantity of water savings at a reasonable cost for a wide range of water user groups. Descriptions of the quantity, cost, and reliability of the projected water savings are presented in Section 5E.7, Appendix C, and Appendix K.	Yes
RWPGs shall consider strategies to address any issues identified in the information compiled by the Board from the water loss audits performed by retail public utilities pursuant to §358.6 of this title (relating to Water Loss Audits). [31 TAC 357.34(f)(2)(D)]	An enhanced water loss control program is part of the Water Conservation Package recommended for each municipal WUG.	Yes
RWPs shall include a subchapter consolidating the RWPG's recommendations regarding water conservation. RWPGs shall include in the RWPs model water conservation plans pursuant to Texas Water Code §11.1271. [31 TAC 357.34(g)]	The RWPG recommendations on water conservation are consolidated in Section 5E. Model water conservation plans for municipal, manufacturing, irrigation, and steam electric power WUGs are presented online at www.regioncwater.org/2016 Region C Plan/Model Water Conservation Plans.pdf.	Yes
RWPGs shall perform a secondary water needs analysis for all WUGs and WWPs for which conservation water management strategies or direct reuse water management strategies are recommended. This secondary water needs analysis will calculate the water needs that would remain after assuming all recommended conservation and direct reuse water management strategies are fully implemented. The resulting secondary water needs volumes shall be presented in the RWP by WUG and WWP and decade. [31 TAC 357.33(e)]	The secondary water needs analysis is presented in Section 4A.	Yes

Table 5E.13 (continued)

Requirement	Evaluation	Fulfilled?
RWPGs shall describe the level of implementation of previously recommended water management strategies. Information on the progress of implementation of all water management strategies that were recommended in the previous RWP, including conservation and drought management water management strategies; and the implementation of projects that have affected progress in meeting the state's future water needs. [31 TAC 357.45(a)]	The level of implementation of previously recommended water conservation strategies in Region C is summarized in Table 5E.6.	Yes

SECTION 5E
LIST OF REFERENCES

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(24) Texas Administrative Code Title 31, Part 10, Chapter 358, [Online], Available URL: http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=31&pt=10&ch=358&rl=Y.

5F Texas Water Development Board Required Tables

The Texas Water Development Board requires summary tables showing specific information on all water management strategies. Those tables can be found in Appendix U of this report, with the exception of the Population and Demand Reports which are contained in Appendix F and G, respectively. The tables are based on information from the Texas Water Development Board online planning database (DB17) and reflect the most current information in the database at the time of the printing of this report. Due to limitations associated with DB17, Region C desires the opportunity to review the DB17 data and make subsequent adjustments in cases where there is a significant difference between DB17 and this paper plan, should the need arise in the future. These adjustments should be allowed without TWDB requiring an errata or amendment to the plan. There may be slight numerical differences between DB17 and this printed regional water plan due to rounding associated with the regional water plan preparation and online data entry. In any instances where numbers in the regional water plan and the online planning database differ by an inconsequential amount, the data in the online planning database (DB17) shall take precedence over the associated number in the regional water plan for the purpose of development of the State Water Plan and for the purposes of TWDB financing through the State Water Implementation Fund for Texas (SWIFT) fund.

6 Impacts of Regional Water Plan and Consistency with Protection of Water Resources, Agricultural Resources, and Natural Resources

The previous section presented a set of recommended water management strategies for Region C wholesale water providers and water user groups. This section discusses the impacts of the recommended water management strategies on key parameters of water quality, the impacts of moving water from rural and agricultural areas, and impacts to third parties. It also discusses how the regional water plan is consistent with the long-term protection of the state's water, agricultural, and natural resources.

6.1 Impacts of Recommended Water Management Strategies on Key Water Quality Parameters

For a given water resource, the impact of water management strategies on key water quality parameters is evaluated by comparing current water quality conditions with anticipated water quality conditions when water management strategies are in place. Many of the recommended water management strategies involve diverting water from one water body and discharging this water to another water body. For these strategies, the difference in the quality of the two waters, the quantity of water discharged, and the effectiveness of any mitigation are used to project the impact on the receiving water. Selection of the key water quality parameters used for this comparison is based on the importance of these parameters to the use of the water resource.

The recommended water management strategies can be grouped into the following strategy types:

- Existing surface water sources
- New surface water sources
- Existing groundwater sources
- New groundwater sources
- Direct reuse
- Indirect reuse
- Conservation
- Other

In general, each strategy within a strategy type is anticipated to have a similar qualitative impact on key water quality parameters in the receiving water. Exceptions to this generalization are addressed where appropriate. The strategy type defined as “other” includes strategies that do not involve discharge of one source to another and, therefore, have no impact on water quality in the receiving water. Examples of strategies in this category include increased pipeline capacity to a particular water user group or connection of a water user group to a wholesale provider.

The following sections define the parameters selected as key water quality parameters and present the evaluation of impacts of recommended water management strategies on these key parameters.

Selection of Key Water Quality Parameters

The selection of key water quality parameters involved a two-stage approach. First, a list of candidate water quality parameters was compiled from several sources. Then, key water quality parameters were selected from the list of potential parameters based on the general guidelines described below.

Candidate water quality parameters were identified using the following sources:

- Parameters regulated by the Texas Commission on Environmental Quality (TCEQ) in the Texas Surface Water Quality Standards (TSWQS)(1)
- Parameters considered for the TCEQ Water Quality Inventory in evaluation of whether water body uses are supported, not supported, or have water quality concerns. The designated water body uses included in the Water Quality Inventory are:
    - Aquatic life use
    - Contact recreation use
    - General use
    - Fish consumption use
    - Public water supply use
- Parameters that may impact suitability of water for irrigation
- Parameters that may impact treatability of water for municipal or industrial supply.

The first two categories above represent environmental water quality parameters, and the last two categories represent water quality as related to water uses.

To develop a manageable and meaningful list of key water quality parameters, the following general guidelines were established for parameter selection:

- Selected parameters should be representative of water quality conditions that may be impacted on a regional scale and that are likely to be impacted by multiple water management strategies within the region. Water quality issues associated with localized conditions (such as elevated levels of a toxic material within one water body) will be addressed as necessary within the environmental impact evaluations of the individual water management strategies for each water user group.

- Sufficient data must be available for a parameter in order to include it as a key water quality parameter. If meaningful statistical summaries cannot be carried out on the parameter, it should not be designated as a key water quality parameter.

The TCEQ has regulated additional parameters in the TSWQS since the development of the 2011 Plan. Newly regulated parameters include nonylphenol and diazinon for all segments, and dissolved oxygen, copper, aluminum, chlorophyll-a, and *E. coli* for certain segments. With the exception of chlorophyll-a, these parameters will be addressed as necessary within the environmental impact evaluations of the individual water management strategies for each water user group. In addition, dissolved oxygen (DO) concentrations are protected during wastewater discharge permitting, and any agency that proposes to discharge biochemical oxygen demand (BOD) as part of a water management strategy would have to show that the discharge would meet local DO standards to obtain a discharge permit. Finally, little has changed since the 2011 Plan in terms of parameters that may impact suitability for irrigation, municipal, or industrial purposes.

For the *2016 Region C Water Plan*, the Region C RWPG has selected the same key water quality parameters for consideration that were used in the 2006 and 2011 Plans. A detailed discussion of the selection of key water quality parameters and definitions of baseline conditions for these parameters is included in Appendix M. Table 6.1 summarizes the key water quality parameters selected by the Region C Water Planning Group.

Table 6.1
Region C Key Water Quality Parameters

Surface Water	Groundwater
Ammonia Nitrogen	Total Dissolved Solids (TDS)
Nitrate Nitrogen	
Total Phosphorus	
Chlorophyll-a	
Total Dissolved Solids (TDS)	

Evaluation of Water Quality Impacts

Impacts of recommended water management strategies on key water quality parameters were assessed by comparing the water quality of the source water for a given strategy with that of the receiving water. This comparison included an evaluation of historical median concentrations of key parameters, together with consideration of data quality, relative quantities of water, and planned mitigation measures (e.g., treatment, blending, or other operational strategies that serve to mitigate water quality impacts). Each recommended strategy was assigned one of the following five anticipated impact ratings: low, medium low, medium, medium high, and high. (The quantitative impacts on key water quality parameters are discussed in more detail in Appendix P.) No recommended or alternative water management strategy is anticipated to have more than a "medium" impact on key water quality parameters. A "medium" impact is considered to be an impact that results in some changes in water quality, but does not result in impairment of the designated uses of the water body.

The following sections present a discussion of the anticipated water quality impacts for each strategy type. Table 6.2 summarizes the range of anticipated water quality impacts within these strategy types.

Table 6.2
Range of Anticipated Impacts on Key Water Quality Parameters by Strategy Type

Strategy Type	Range of Anticipated Impacts on Key Water Quality Parameters	Comments
Existing Surface Water Sources	Low to Medium	Lake Texoma strategies assumed to include mitigation for TDS.
Existing Groundwater Sources	Low to Medium Low	
New Surface Water Sources	Low to Medium	Water quality in new sources difficult to predict.
New Groundwater Sources	Medium Low to Medium	
Direct Reuse	Low/Positive	Potential positive impact resulting from reduced nutrient and TDS loadings to surface waters.
Indirect Reuse	Medium	Assumes mitigation to control impacts on nutrients and TDS, if necessary.
Conservation	Low	
Other	Low	Includes strategies not involving blending of two water sources (e.g. direct pipeline to a treatment plant).

Existing Surface Water Sources

For strategies utilizing existing surface water sources, impacts on key water quality parameters vary depending on a number of factors, including the location of the source and the intended destination of the water transfer. For strategies that involve pumping existing surface water directly to a water treatment plant, no impact on water quality is anticipated (resulting in a rating of "low"). However, when water is pumped from one source to another, the impacts will depend on the existing water quality of the two sources, as well as the quantities to be transferred and any mitigation that may be applied.

Several of the recommended and alternative strategies call for increased use of water from East Texas reservoirs. In general, reservoirs in East Texas have higher concentrations of nutrients (i.e., nitrogen and phosphorus) than many of the Region C reservoirs. The ultimate impact of importing water with higher nutrient concentrations to Region C reservoirs is difficult to predict due to the complex kinetic relationships between nutrients and chlorophyll-a. Strategies that involve importing water from East Texas reservoirs to Region C reservoirs may result in increases in ammonia, nitrate, total phosphorus, and/or chlorophyll-a, but are not likely to lead to impacts that would impair the designated uses of the Region C water bodies. In general, the TDS concentrations in East Texas reservoirs are lower than in Region C reservoirs. Therefore, in nearly all cases, transfer of East Texas water to Region C reservoirs will decrease TDS concentrations in the receiving water bodies. All of the recommended water management strategies involving importation of East Texas water to Region C are anticipated to have a "low" or "medium low" impact on key water quality parameters.

In addition to strategies that include transfers from East Texas reservoirs to Region C reservoirs, several recommended and alternative strategies include intermediate transfers between reservoirs outside of Region C. These include transfers from Wright Patman Lake to Lake Fork Reservoir and Chapman Lake and from Toledo Bend Reservoir to Lake Fork Reservoir, Lake Tawakoni, and Chapman Lake. Although there are some minor variations in water quality among these reservoirs, these strategies are all anticipated to have no more than a "medium-low" impact on the key water quality parameters.

Lake Texoma is included in the recommended and alternative strategies for multiple entities. The water will be transported directly to a water treatment plant, and TDS from Lake Texoma will not directly impact any reservoirs in Region C. However, due to indirect reuse strategies, much of the TDS from Lake Texoma will eventually be discharged to Region C reservoirs. Currently, typical TDS concentrations in Lake Texoma are in the 800-1,200 milligram per liter (mg/L) range. Most Trinity River Basin reservoirs in Region C have TDS standards (from the TSWQS) in the 400-500 mg/L range. Therefore, to import a significant quantity of Lake Texoma water into the Trinity River Basin, mitigation will likely be needed in the form of desalination or blending with another lower TDS water (such as an East Texas source) to meet drinking water standards, to prevent significant increases in TDS concentrations in receiving water bodies, and to prevent violation of the Texas Surface Water Quality Standard for TDS. To project the impact of strategies involving use of Lake Texoma water, it has been assumed that mitigation measures will be used to maintain TDS concentrations in the receiving water body at levels that do not violate the Texas Surface Water Quality Standard for TDS. In addition, for strategies that use desalination treatment as mitigation, disposal of the highly saline reject stream can result in increased TDS concentrations, depending on the method and location of disposal. Based on these issues, the recommended strategy involving importation of Lake Texoma water to Region C is anticipated to have no more than a "medium" impact on key water quality parameters.

New Surface Water Sources

In general, the impact of the development of new surface water sources on key water quality parameters will be similar to that of existing reservoir sources. All of the proposed reservoir sites identified as potential Region C sources are located in the Red, Trinity, Sulphur, or Neches River Basins. As such, the impacts on key water quality parameters of importing water from new reservoirs are likely to be similar to the impacts of importing water from existing East Texas sources to the Trinity River Basin. (The proposed reservoir in the Red River Basin, Lower Bois d'Arc Creek Reservoir, is on a low-TDS tributary of the Red River.) All strategies involving the importation of water from new reservoirs to Trinity River Basin reservoirs are anticipated to have no more than a "medium" impact on key water quality parameters.

One new surface water strategy involves the transfer of water between reservoirs that are both outside of Region C. That is a recommended strategy for Dallas Water Utilities involving transfer of Lake Columbia water to Lake Palestine. Another recommended strategy for Dallas Water Utilities is to use run-of-river supplies from the Neches River operated as a system with Lake Palestine. Both of these strategies are anticipated to have no more than a "medium" impact on water quality parameters.

Existing Groundwater Sources

Since none of the recommended strategies involving existing groundwater sources include blending of groundwater within a supply reservoir, no significant impacts on key surface water quality parameters are expected. Potential impacts on key water quality parameters resulting from alternative and recommended strategies in this category are anticipated to be "low" or "medium low".

New Groundwater Sources

There are no new major groundwater sources included in the recommended water management strategies for Region C. However, several alternative strategies propose obtaining water from groundwater sources that are new to the region, including groundwater from Anderson, Wood, Upshur, and Smith Counties. The potential receiving water body for groundwater from Wood, Upshur, and Smith Counties is Lake Fork Reservoir (Dallas Water Utilities). Groundwater from these counties is drawn from the Carrizo-Wilcox and Queen City aquifers and has a median TDS concentration that is higher than that in Lake Fork Reservoir and somewhat greater than the stream standard for Lake Fork Reservoir. The TDS concentration in Wood, Upshur, and Smith Counties groundwater relative to the stream standard may limit the use of this resource in Region C. However, the median nitrate concentration appears to be high in comparison to the median nitrate concentration in Lake Fork Reservoir. As a result, this strategy is anticipated to have a “medium” impact on key water quality parameters.

Lake Lavon (North Texas Municipal Water District) is the potential receiving water body for Anderson County groundwater. Anderson County groundwater, drawn from the Carrizo-Wilcox aquifer, has a median TDS concentration that is somewhat greater than that in Lake Lavon. As a result this strategy is anticipated to have a “medium low” impact on key water quality parameters.

Direct Reuse

By definition, direct reuse involves the transfer of treated wastewater effluent directly to a point of use and not into another water body. As such, the impact on key water quality parameters for all direct reuse strategies is anticipated to be “low.” In some cases there may be a positive impact. By reducing the quantity of effluent discharged into a stream or reservoir segment, the nutrient and TDS loads to that segment will also be reduced, thereby potentially improving downstream water quality.

Indirect Reuse

Indirect reuse is a recommended strategy for multiple entities within Region C. This strategy involves the discharge of treated wastewater effluent into a body of water used for water supply. Treated wastewater can contain nutrient and TDS concentrations that are high in comparison to the receiving water. However, for most of the recommended strategies that include indirect reuse, some form of mitigation (e.g., advanced wastewater treatment, constructed wetlands, blending, etc.) is planned to address potential water quality impacts associated with nutrients and TDS. For the purposes of this evaluation, it is assumed that some form of mitigation for potential water quality impacts associated with the key parameters will be implemented, if necessary, such that the designated uses of the water body will not be impaired. For this reason, recommended indirect reuse strategies are anticipated to have no more than a “medium” impact on key water quality parameters.

Conservation

Conservation is a recommended strategy for all municipal water user groups in Region C, including those without shortages. Water conservation is the development of water resources and practices to reduce the consumption or loss of water, increase the recycling and reuse of water, and improve the efficiency in the use of water. Water conservation plans are designed to implement practices to conserve water and quantitatively project water savings. The water conservation measures recommended in Region C are not expected to affect water quality adversely. The results should generally be beneficial because the demand on surface and groundwater resources will be decreased. Quantifying such positive impacts could be very difficult. Chapter 5 contains additional discussion of water conservation.

Summary

The recommended water management strategies in this plan were developed based on the principle that designated water quality and related water uses as shown in the state water quality management plan shall be improved or maintained. Based on the projected impacts of recommended water management strategies on key water quality parameters, some strategies may require mitigation or advanced treatment to obtain the permits necessary for implementation.

6.2 Impacts of Recommended Water Management Strategies on Moving Water from Rural and Agricultural Areas and Impacts to Third Parties

This section discusses the potential impacts of the *2016 Region C Water Plan* on rural and agricultural activities and possible impacts to third party entities, and specifically focuses on the impacts associated with moving water from rural and agricultural areas. This section also discusses the considerations given during the development of the plan to protect rural and agricultural activities.

6.2.1 Impact on Agricultural Resources

The *2016 Region C Water Plan* includes several strategies that move water from rural areas to urban centers. These strategies fall into two general categories:

- New connections to existing water sources: Toledo Bend Reservoir to NTMWD, Lake Palestine to DWU, Texoma to NTMWD and GTUA, Oklahoma water to NTMWD, etc.
- New reservoirs: Marvin Nichols, Ralph Hall, Lake Columbia, Lake Tehuacana, and Lower Bois d'Arc Creek.

Large groundwater projects also may move large quantities of water from rural to urban areas, but these are not recommended strategies. Both the Freestone/Anderson County project and the Carrizo-Wilcox project in Wood, Upshur, and Smith Counties, located outside of the Region C planning area, are identified as alternative strategies.

The impacts from the recommended water management strategies will vary depending on the location of the project, current use of the water, and the quantity of water that is being transferred. The types of impacts that may occur include:

- Transfer of water rights from agricultural use to other uses.
- Removal of agriculture through inundation from new reservoirs.
- Changes in stream flow immediately downstream of a new reservoir.
- Increased water level fluctuations at existing lakes as more water is used.

The recommended water plan considered many different factors as strategies were developed and recommended for inclusion. One consideration is the development of a plan that minimizes the potential impacts to rural and agricultural areas through utilization of existing sources with a strong emphasis on conservation and reuse. The existing and recommended 2070 water conservation and reuse strategies, including those that are assumed in the demands, will meet more than one million acre-feet per year of the pre-conservation demand. The emphasis on conservation and reuse reduces the number of strategies and amount of water needed from other sources, including transfers of water from rural and agricultural areas.

Other protections for agricultural and rural uses were incorporated in the process of evaluating and allocating water supplies. Specifically, these include:

- Existing and proposed surface water supplies were evaluated under the prior appropriation doctrine that governs surface water rights and protects senior water rights. In the final *2016 Region C Water Plan*, there are no transfers of irrigation water rights to urban uses.
- The amount of available supplies from existing sources was limited to firm yield. Existing uses from these sources were protected through the allocation process and only the amount of water that is currently permitted (up to the firm yield) was considered for transfer to Region C. Three existing reservoirs (Texoma, Wright Patman and Toledo Bend) are currently seeking or are recommended to seek additional water rights. This additional water would not impact agricultural or rural activities.
- Supplies from new reservoirs considered instream flow releases in accordance with the planning guidelines set forth by the TWDB. These releases protect recreational and non-consumptive water needs downstream of the proposed reservoir sites.

In Region C there is little irrigated agriculture, with irrigated cropland making up less than 2 percent of harvested cropland[(2)]. Most of the irrigation water demand is associated with golf course irrigation in and near urban areas, and much of this water need will be met through reuse. There are no recommended transfers of needed irrigation to other uses and all irrigation and livestock water needs are met through the recommended plan. The potential impacts to agricultural and rural areas are limited to the loss of land from inundation of new reservoirs. The total acreage that would be flooded if all recommended water management strategies from the *2016 Region C Water Plan* were implemented is 102,454 acres. Impacts from new reservoirs will be mitigated as part of the permitting process. New reservoirs also can stimulate the rural economy through new recreational business and local improvements. The new reservoirs will provide a new water source for rural activities. Each of the proposed reservoir sites includes water set aside for local water supplies.

6.2.2 Third Party Impacts of Moving Water from Rural and Agricultural Areas

Possible third party impacts include loss of land and timber, impacts to existing recreational business on existing lakes due to lower lake levels, and impacts to recreational stream activities. Economic studies have been conducted for two of the reservoirs proposed for Region C, and in each case they indicate a significant net economic benefit to the region of origin[(3),(4)].

6.2.3 Impacts of Recommended Water Management Strategies on Groundwater and Surface Water Inter-relationships

The impacts of recommended water management strategies in Region C on groundwater and surface water relationships are expected to be minimal. For surface water, the supplies used do not exceed the firm yield of the reservoir. This provides some water in the lakes through the drought of record and provides some protections from future droughts. For groundwater, the desired future conditions, as adopted by the GMAs, were honored for both currently developed supplies and potential future strategies. By not exceeding the modeled available groundwater, long-term effects on groundwater and surface water interrelationships were minimized since these complex relationships are considered by the GMA when selecting the DFCs.

6.2.4 Other Factors

The impacts to recreational activities and recreational businesses at existing lakes are expected to be low. While water levels at local and rural lakes may fluctuate more under the recommended plan, these water level changes are within the design constraints of the reservoirs. Five of the major water transmission strategies have water sources that are located in highly prolific rainfall areas. Significant changes in water levels at these sources would be limited to extreme drought conditions.

Impacts to recreational stream activities are mitigated through the permitting process and requirements for instream flow releases. New reservoirs offer new recreational opportunities and recreational business growth that could spur the local economies of rural areas.

6.2.5 Interbasin Transfers of Surface Water

There are several recommended and alternative water management strategies involving interbasin transfers of surface water to Region C. These strategies propose moving water from the Red, Neches, Sabine, and Sulphur Basins to the Trinity Basin. The needs, as reported in DB17, for each of these basins of origin and the receiving basin (Trinity) are included in Table 6.3. By 2040, the needs in the Trinity Basin exceed the needs in each of the basins of origin.

Table 6.3
Water Needs by Basin and Region Related to Interbasin Transfers to Region C
(Acre-Feet per Year)

Basin	Region	2020	2030	2040	2050	2060	2070
Red	A	13,579	21,828	30,125	38,586	47,050	55,781
	B	34,067	35,896	38,434	41,348	45,366	49,440
	C	5,234	15,368	18,619	24,268	35,583	54,294
	D	22,422	23,352	25,010	26,822	29,237	32,191
	G	3,032	5,426	7,719	7,518	5,867	5,016
	O	363,520	382,335	407,237	421,236	434,175	460,930
	Total	441,854	484,205	527,144	559,778	597,278	657,652
Neches	C	0	0	0	0	0	0
	D	342	386	423	462	497	527
	H	11,115	11,145	11,172	11,199	11,225	11,254
	I	145,100	195,625	210,993	231,661	252,934	275,915
	Total	156,557	207,156	222,588	243,322	264,656	287,696
Sabine	C	292	1,083	1,817	3,097	5,215	7,030
	D	72,906	86,572	104,711	122,425	146,861	180,501
	I	5,774	15,271	25,056	35,514	55,548	77,009
	Total	78,972	102,926	131,584	161,036	207,624	264,540
Sulphur	C	14	44	54	142	571	1,025
	D	27,685	29,306	35,991	41,377	50,901	93,706
	Total	27,699	29,350	36,045	41,519	51,472	94,731
Trinity	B	1,086	548	531	365	353	353
	C	125,390	357,776	591,494	814,132	1,049,983	1,297,544
	D	11	11	27	81	160	274
	G	4,454	5,214	7,671	9,873	12,058	14,924
	I	756	974	1,213	1,478	1,770	2,169
	H	4,237	4,996	5,329	6,094	7,120	8,237
	Total	135,934	369,519	606,265	832,023	1,071,444	1,323,501

6.3 Invasive and Harmful Species

The appearance of several invasive and/or harmful species (including zebra mussels, giant salvinia, and golden algae) poses a potential threat to water supplies throughout the state of Texas. Continued monitoring and management by water suppliers in Region C will be necessary in the coming decades. Invasive species will likely be an ongoing area of interest to Region C, as the appearance of additional invasive species in the future remains a possibility. The issue of invasive and harmful species should be considered as plans for interbasin transfers of water supplies are implemented. A more extensive discussion of these invasive species is found in Section 1.11 of this report.

6.4 Description of How the Regional Water Plan is Consistent with Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources

The development of viable strategies to meet the demand for water is the primary focus of regional water planning. However, another important goal of water planning is the long-term protection of resources that contribute to water availability and to the quality of life in the state. The purpose of this section is to describe how the *2016 Region C Water Plan* is consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources. The requirement to evaluate the consistency of the regional water plan with protection of resources is found in 31 TAC Chapter 357.14(2)(C) (1), which states, in part:

> "The regional water plan is consistent with the guidance principles if it is developed in accordance with §358.3 of this title (relating to Guidelines), §357.5 of this title (relating to Guidelines for Development of Regional Water Plans), §357.7 of this title (relating to Regional Water Plan Development), §357.8 of this title (relating to Ecologically Unique River and Stream Segments), and §357.9 of this title (relating to Unique Sites for Reservoir Construction)."

6.4.1 Consistency with the Protection of Water Resources

Five river basins provide surface water for Region C, and six aquifers provide groundwater to the region. The four major river basins within Region C boundaries are the Trinity River Basin, the Red River Basin, the Brazos River Basin, and the Sabine River Basin. Only a small portion of the Sulphur River Basin lies within the Region C boundaries, but this basin provides important surface water supplies for Region C from Chapman Lake. These river basins are depicted on Figure I.1, in the Introduction of this report. The region's groundwater resources include two major aquifers, the Trinity and Carrizo-Wilcox, and three minor aquifers, the Woodbine, the Nacatoch, and the Queen City. The extents of these aquifers within the region are depicted on Figure 1.2 in Chapter 1.

The Trinity River Basin provides the largest amount of water supply in Region C. Surface reservoirs in the Trinity Basin in Region C with conservation storage over 50,000 acre-feet include:

Lake Bridgeport	Lake Lavon
Eagle Mountain Lake	Lake Ray Hubbard
Benbrook Lake	Bardwell Lake
Joe Pool Lake	Navarro Mills Lake
Grapevine Lake	Richland-Chambers Reservoir
Ray Roberts Lake	Cedar Creek Reservoir
Lewisville Lake	Lake Fairfield

Other major reservoirs supplying surface water to Region C include the following:

- Lake Texoma in the Red River Basin.
- Only a small portion of the Sabine River Basin lies within Region C; however, Region C receives water from two major water supply reservoirs located in Region D and the Sabine Basin (Lake Tawakoni and Lake Fork Reservoir).
- Only small portions of the Brazos River Basin lie within Region C, and no Brazos River Basin reservoirs with conservation storage over 50,000 acre-feet are located in Region C.
- Chapman Lake is located in the Sulphur River Basin in Region D and provides water supply to Region C.
- Lake Palestine is permitted for use in Region C, but is located in the Neches River Basin in Region I.

Of the groundwater resources in Region C, the Trinity aquifer provides about 66 percent of the region's groundwater, and about 21 percent comes from the Woodbine aquifer. The remainder of the groundwater is from the Carrizo-Wilcox (7 percent), the Nacatoch (1 percent), the Queen City (2 percent), and undifferentiated/other aquifers (3 percent).

To be consistent with the long-term protection of water resources, the plan must recommend strategies that minimize threats to the region's sources of water over the planning period. The water management strategies identified in Chapter 5 were evaluated for threats to water resources. The state-developed surface Water Availability Models (WAMs) and Groundwater Availability Models (GAMs) were used to evaluate surface water and groundwater supplies, respectively. The results from these models were used to determine the amount of water supply that could be allocated while still protecting the sustainability of the water resources. The recommended strategies represent a comprehensive plan for meeting the needs of the region while effectively minimizing threats to water resources.

Descriptions of the major strategies and the ways in which they minimize threats include the following:

- Water Conservation. Strategies for water conservation have been recommended that will significantly reduce the demand for water, thereby reducing the impact on the region's groundwater and surface water sources. Not including reuse, water conservation practices are expected to reduce the municipal water use in Region C by 131,108 acre-feet per year by 2070 and reduce non-municipal water use by 4,884 acre-feet per year by 2070, reducing impacts on both groundwater and surface water resources (Table 5E.9).
- Reuse Projects. Existing and recommended reuse projects in Region C account for a total water supply of 427,011 acre-feet per year as of 2070 (Table 5E.7). The majority of the recommended reuse is for municipal use. A portion of the reuse water is for golf course and general irrigation in municipal areas and for steam electric power generation. These strategies will provide an economical and environmentally desirable source of water for Region C and delay the need for development of new water supplies.
- Conservation and Reuse. The existing and recommended 2070 water conservation and reuse strategies, including those that are assumed in the demands, will meet more than 1.18 million acre-feet per year (or 41.7 percent) of the pre-conservation demand.
- Full Utilization of Existing Surface Supplies Committed to Region C. A number of recommended strategies for Region C are intended to make full use of existing supplies. Most reservoirs in Region C will be utilized at or near their firm yield capacities but not beyond, thus protecting these reservoirs and allowing the continued water supplies throughout a drought similar to the drought of record. In addition, by fully utilizing the existing water supplies, water providers will delay the need for new supplies.
- Investigation of Existing Supplies Not Committed To Region C. As part of this planning process, the Region C Water Planning Group investigated the cost and availability of existing water supplies that might be made available to Region C. Cost-effective existing supplies are included in the *2016 Region C Water Plan*.
- Optimal Use of Groundwater. This strategy is recommended for entities with limited alternative sources and sufficient groundwater supplies to meet their needs. Groundwater availability reported in the plan is the long-term sustainability of the aquifer, and is based on aquifer recharge.
- New Surface Reservoirs. A number of new surface reservoirs have been recommended as water management strategies. They include: Lower Bois d'Arc Creek Reservoir in 2020, Lake Ralph Hall in 2030, Lake Tehuacana in 2040, Marvin Nichols Reservoir (as part of the Sulphur Basin Supplies strategy) in 2070, and Lake Columbia in 2070. These reservoirs will have significant impacts on the land, homes, and habitat that will be inundated and on the existing stream segments which will be altered. As part of reservoir development, the Corps of Engineers will determine the quantity of land that should be set aside to mitigate for impacts to aquatic and wildlife habitats. Landowners within the reservoir sites will be compensated for their land. These new reservoirs will make releases for environmental water needs in accordance with environmental regulations and permit conditions, which will help sustain aquatic and wildlife habitat downstream from the reservoir. Water right permits for these reservoirs will be granted based on results from the WAMs which will ensure that these new water rights do not interfere with existing prior water rights, thus protecting existing water resources of the state.

6.4.2 Consistency with Protection of Agricultural Resources

Many areas of Region C are heavily urbanized, and the region has comparatively little irrigated agriculture. In the year 2011, 4 percent of the region's total water use was for irrigation and livestock, as shown in Table 1.4, and most of the irrigation shown in that table was used for golf course irrigation rather than agricultural irrigation. None of the recommended water management strategies involve transferring water rights from agricultural use to another use. Thus, the Region C plan protects current agricultural water use.

The proposed reservoirs in the *2016 Region C Water Plan* will inundate some agricultural areas, but agricultural use in the reservoir sites is limited. The proposed reservoirs located in Region C include Lower Bois d'Arc Creek Lake, Lake Ralph Hall and Lake Tehuacana. Very little agricultural activity exists in the area of these proposed reservoirs. During the permitting process, site specific analyses would address this topic in more detail.

The proposed Marvin Nichols Reservoir in the Region C Plan is located outside of Region C. The area of the proposed Marvin Nichols Reservoir site has some agricultural activity, including cattle raising and timber. This area is also known to have some hunting leases for game animals. A quantitative analysis of the impacts of the proposed Marvin Nichols Reservoir (both the recommended configuration for the Sulphur Basin Supplies strategy and the alternative strategy configuration at 328 feet, msl) on agricultural and natural resources in included in Appendix Y.

The proposed Lake Columbia in the Region C Plan is located outside of Region C. The area of the proposed Lake Columbia site has 11,330 acres. Very little agricultural activity exists in this area and site specific analyses will be conducted during permitting process.

6.4.3 Consistency with Protection of Natural Resources

Region C contains many natural resources that must be considered in water planning. Natural resources include threatened or endangered species; local, state and federal parks and public land; and energy/mineral reserves. The Region C plan is consistent with the long-term protection of these resources. A brief discussion of consistency of the plan with protection of natural resources follows.

Threatened/Endangered Species

A list of threatened or endangered species located within Region C is contained in two tables in Chapter 1. Table 1.13 presents the Federal Endangered or Threatened Species in Region C, and Table 1.14 lists the State Species of Special Concern in Region C. According to the Texas Parks and Wildlife Department's listing[5], there are 10 endangered species and 26 threatened species whose habitats are located in Region C counties. According to the Federal Listing from the U.S. Fish and Wildlife Service[6], there are eight endangered species and two threatened species whose habitats are located in Region C counties.

All recommended strategies in Region C have been chosen with the possible effects on these threatened and endangered species in mind. For example, strategies that are likely to disturb threatened or endangered species habitat include mitigation allowances that set aside additional land for that habitat.

Wetland Habitats

The Region C plan includes some projects that would have impacts to existing wetland habitats. The Marvin Nichols Reservoir project would inundate a portion of the state's Priority 1 bottomland hardwoods. These wetlands are considered high value to key waterfowl species and would require comparable mitigation. As discussed in Section 6.4.1, state and federal agencies will determine the quantity of land that should be set aside to mitigate for impacts to aquatic and wildlife habitats during reservoir development. The quantity and quality of the mitigation lands will be designed to achieve no net loss of wetlands functions and values. In addition, the development of a lake will create new wetland and aquatic habitats.

Parks and Public Lands

The Texas Parks and Wildlife Department operates several state parks in Region C listed below[7]:

Bonham State Park in Fannin County	Purtis Creek State Park partially in Henderson County
Cedar Hill State Park in Dallas County	Caddo National Grasslands Wildlife Management Area in Fannin County
Eisenhower State Park in Grayson County	Ray Roberts State Park in Cooke, Denton, and Grayson Counties
Fairfield Lake State Park in Freestone County	Richland Creek Wildlife Management Area in Freestone and Navarro Counties
Lake Mineral Wells State Park in Parker County	Ray Roberts Lake Wildlife Management Area in Cooke, Denton, and Grayson Counties
Fort Richardson & Lost Creek Reservoir State Park in Jack County	Cedar Creek Islands Wildlife Management Area in Henderson County.

Federal government natural resource holdings in Region C include the following:

- Parks and other land around all of the Corps of Engineers lakes in the region (Texoma, Ray Roberts, Lewisville, Lavon, Grapevine, Benbrook, Joe Pool, Bardwell, and Navarro Mills)

- Hagerman National Wildlife Refuge on the shore of Lake Texoma in Grayson County
- Lyndon B. Johnson National Grasslands in Wise County
- The Caddo National Grasslands in Fannin County

In addition, there are a number of city parks, recreational facilities, and public lands located throughout the region.

Increased utilization of some reservoirs may lower the lake levels during a severe drought. This may affect the parks and public lands surrounding these reservoirs, but the strategies recommended in the Region C plan will have no additional impact on these water resources beyond what has already been allowed for in their water right permits. None of the recommended water management strategies evaluated for the Region C plan are expected to adversely impact parks or public lands.

Energy Reserves

Oil and natural gas fields are important natural resources in portions of Region C. Most of the oil production is in Jack, Wise, Cooke, Navarro, and Grayson Counties(8), and most of the natural gas production is in Freestone, Parker, Denton, Tarrant, and Wise Counties(9). Gas production in the Barnett Shale has rapidly increased in the past decade due in large part to improvements in hydraulic fracture stimulation technologies(10). This use of water in gas production has significantly increased the mining use in Region C. None of the recommended water management strategies are expected to impact oil or gas production in the region. The proposed Tehuacana Reservoir location in Freestone County is underlain, in parts, by lignite coal deposits. In 1982, the US Army Corps of Engineers conducted a feasibility report on the recovery of these resources(11). This report concluded that there was economic impetus to mine this deposit to 150 feet. However, the economic environment for the mining and use of coal for power generation has changed substantially since 1982. One major assumption in the report is that the coal could be used at the Luminant's Big Brown Plant near Fairfield, which is only a short distance from the potential mine location near Techaucana. However, in 2011, Luminant ceased coal production at their three current lignite mines and no longer uses lignite coal at the Big Brown Plant due to the EPA Cross-State Air Population Rule(12). Furthermore, in 2014 the EPA proposed a new Clean Power Plan Rule(13), which if it passes, may make coal fired power generation even less attractive. While it is impossible to predict future market changes and conditions, given the current regulatory environment and the trend of closing lignite mines, it is unlikely that the construction of the Tehauanca Reservoir will result in adverse impacts on the coal industry.

6.4.4 Consistency with Protection of Navigation

No commercial navigation activities occur in Region C at this time. For the two river segments identified by the Corps of Engineers as "navigable waters" (Trinity River downstream of Fort Worth and the Red River downstream of Warren's Bend in Cooke County), there are no known plans to initiate navigation activities. This plan has no impact to navigation in Region C.

The Region C recommended strategies also do not impact navigation activities in other regions. Analysis of the proposed reuse projects found that there are limited impacts to stream flows from reuse projects, thus protecting potential downstream navigation activities. The recommended reservoirs located in adjacent regions include sufficient releases that would protect instream uses and downstream navigation activities.

6.5 Impacts of Not Meeting Water Needs

6.5.1 Unmet Needs in Region C

There are several non-municipal WUGs and one municipal WUG with unmet needs in Region C. The non-municipal WUGs with unmet needs are Freestone County mining from 2020 through 2070 and Jack County mining from 2020 through 2070. The Freestone County mining need is unmet because the demand is a function of how the TWDB classifies the mining operation, not an "actual" demand. The demand is from the de-watering of lignite mines from shallow aquifers. It is the amount of water produced by dewatering rather than a true demand, and no supply is needed. The Jack County mining need is unmet because of a lack of available supplies. Based on TWDB historical water use records, the projected demands for this WUG appear to be based on the peak year of water use, rather than trends over multiple years. Thus, the projected demands appear to be higher than the actual use in recent years (2011 use was 902 acre-feet; 2012 use was 99 acre-feet).

Athens in the only municipal WUG in the region with an unmet need during the planning period. The unmet need occurs in 2060 and 2070 in the amount of 2,585 acre-feet per year (with recommended water management strategies for water conservation and an amendment of the Fish Hatcheries permit for reuse). The City of Athens/Athens MWA has limited supplies to serve future municipal water needs without exceeding the Modeled Available Groundwater (MAG) supplies. Athens MWA plans to drill new wells to meet all future demands and has received the permits to do so from the Neches and Trinity Valleys Groundwater Water Conservation District (GCD). However, the groundwater volumes associated with this supply are not within the available MAG amounts. As a result, under TWDB rules the need cannot be shown as being met by these permitted groundwater wells in the Region C or Region I Water Plans. Athens has agreed to show these demands as unmet in the Region I and Region C Plans, but the needs will in fact be met by the development of the permitted well fields. After appropriate revisions to the MAG are made to reflect the permits Athens MWA has received, these needs will be shown as met by the groundwater supplies in future regional water plans.

Conservation was included as a recommended strategy for Athens to help reduce unmet needs and protect the human health and safety of the residents of Athens. Drought management was also considered as a strategy but was not considered feasible for meeting long-term growth in demands. Instead it is intended and encouraged to be used as a means to reduce water usage during drought emergencies through the implementation of the City's Drought Contingency Plan.

6.5.2 Socioeconomic Impacts

If no additional water supplies are developed, Region C will face substantial shortages in water supply over the next 50 years. The Texas Water Development Board (TWDB) provides technical assistance to regional water planning groups in the development of specific information on the socio-economic impacts of failing to meet projected water needs. This information is presented in Appendix N. A summary of the TWDB's socio-economic report is presented in this section.

The TWDB analysis of socio-economic impacts is based on information on potential shortages in Region C provided to the TWDB by Region C. Table 6.4 and Figures 6.1 and 6.2 summarize the TWDB's analysis of the impacts of a severe drought occurring in a single year at each decadal period in Region C. It was assumed that all of the projected shortage was attributed to drought. Under these assumptions, the TWDB's findings can be summarized as follows:

- With the projected shortages, the region's projected 2070 population would be reduced by 68,484.
- Without any additional supplies, the projected water needs would reduce the region's projected 2070 employment by over 373,000 jobs.
- By not meeting water needs in Region C, the annual combined lost income in 2070 is estimated at $34.6 billion.
- The lost water utility revenues (municipal sector only) in 2070 are $3.2 billion.

The projected impact on population and jobs over the planning period is shown on Figure 6.1. The impacts to income and local and state taxes are shown on Figure 6.2.

It is important to note that this socio-economic impact analysis only considers a severe drought occurring in a single year. A drought several years long would have an even greater impact on the region.

Table 6.4
Socio-Economic Impacts in Region C of Not Meeting Projected Demands

Year	Income ($ Millions)	Tax Losses on Production and Imports ($ Millions)	Jobs Lost	Population Losses
2020	$2,581	$314	12,443	2,285
2030	$2,846	$220	15,763	2,894
2040	$6,063	$424	48,570	8,917
2050	$11,751	$845	109,337	20,074
2060	$21,216	$1,556	219,614	40,321
2070	$34,607	$2,598	373,009	68,484

Figure 6.1
Socio-Economic Impacts of Not Meeting Projected Demands

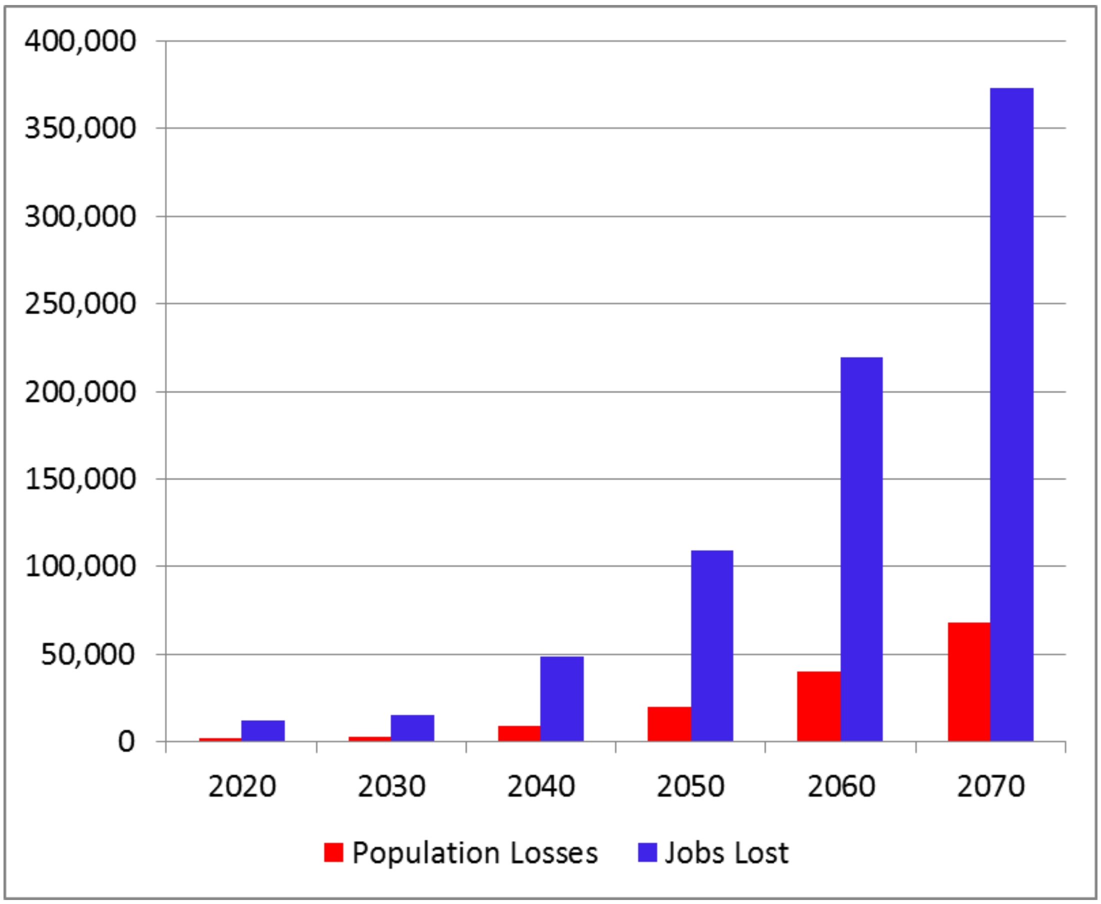
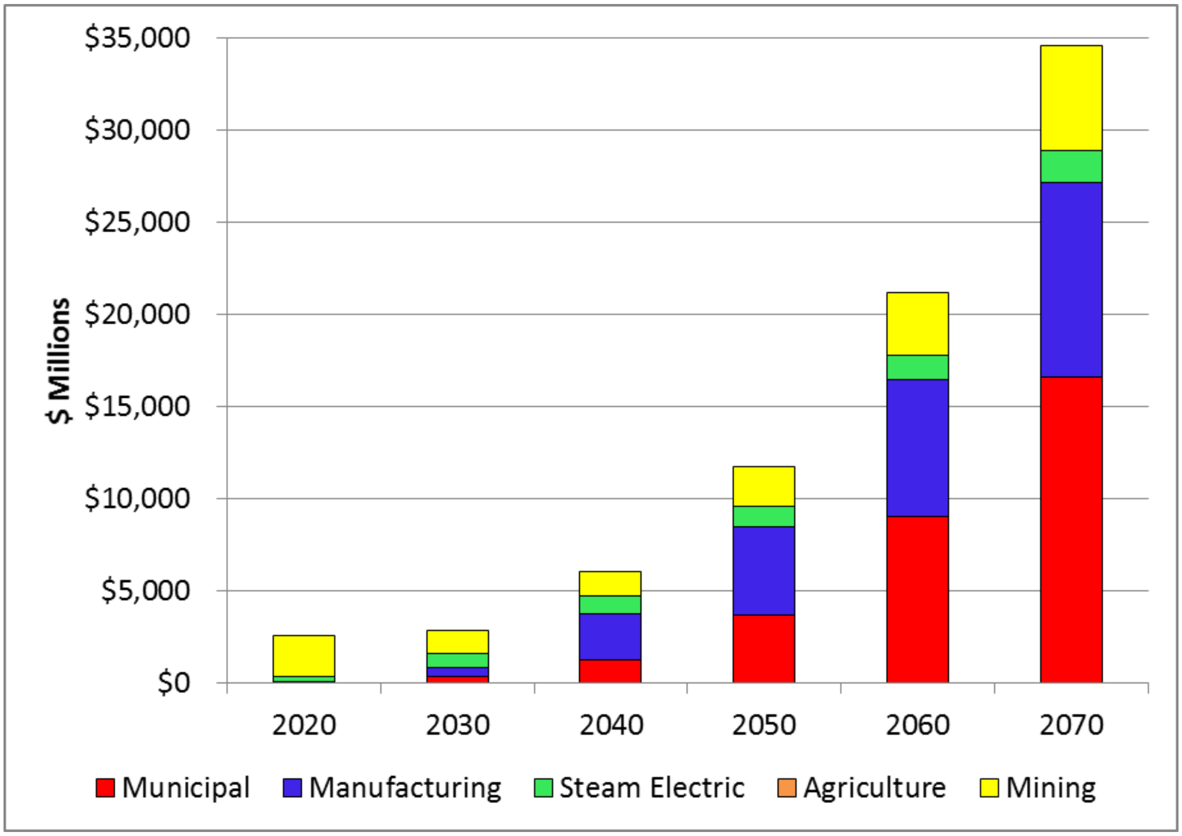


Figure 6.2
Projected Loss of Income with Not Meeting Projected Demands



6.6 Consistency with State Water Planning Guidelines

To be considered consistent with long-term protection of the state's water, agricultural, and natural resources, the Region C plan must be determined to be in compliance with the following regulations[1, 2]:

- 31 TAC Chapter 357.35
- 31 TAC Chapter 357.40
- 31 TAC Chapter 357.41
- 31 TAC Chapter 358.3

The information, data, evaluation, and recommendations included in the Region C plan collectively comply with these regulations. To assist with demonstrating compliance, Region C has developed a matrix addressing the specific recommendations contained in the above referenced regulations. The matrix is a checklist highlighting each pertinent paragraph of the regulations. The content of the *2016 Region C Water Plan* has been evaluated against this matrix. Appendix X contains a completed matrix.

CHAPTER 6
LIST OF REFERENCES

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12 Nelson, Gabriel: Texas Utility to Ide Boilers, Cole Mines in Response to New EPA Rule, New York Times [Online], Available URL: http://www.nytimes.com/gwire/2011/09/12/12greenwire-texas-utility-to-idle-boilers-coal-mines-in-re-68196.html, September 2011.

13 Environmental Protection Agency, Clean Power Plan Proposed Rule [Online] Available URL: http://www2.epa.gov/carbon-pollution-standards/clean-power-plan-proposed-rule, June 2014.

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15 Texas Water Development Board: Chapter 358, State Water Planning Guidelines, Austin, October 1999, amended December 6, 2004.

7 Drought Response

Drought is a natural and recurring meteorological phenomenon where precipitation is significantly below "normal" for a period of time. Relatively mild, short-duration droughts are common throughout Texas and typically result in relatively mild impacts. However, extended severe drought conditions can have serious impacts on water supplies, water suppliers, and water users including:

- Reduction in available water supply leading to shortage conditions;
- Increases in water demand, particularly for seasonal demands such as landscape irrigation;
- Stress on water utility infrastructure due to elevated seasonal peak water demands relative to capacity limitations of water supply infrastructure;
- Deterioration of source water quality;
- Lifestyle and financial impacts to water users associated with restrictions on non-essential water uses (e.g., loss of landscaping); and
- Financial impacts on water suppliers due to reduced revenues from water sales during periods of water demand curtailment.

Due to the potentially devastating effects of drought on both communities and the State's economy, it is important that water suppliers and users consider the potential impacts of drought and develop robust plans to address supply or demand management under drought conditions. This chapter presents information concerning historical droughts in the Region, current drought preparations and responses, recommendations for region-specific drought responses, and region-specific model drought contingency plans.

7.1 Drought of Record in the Regional Water Planning Area

7.1.1 Regional Drought of Record

The Drought of Record (DOR) is typically defined as the worst drought to occur for a particular area during the available period of hydrologic record. Due to the variety of ways in which drought may be characterized (deviation from normal precipitation, temperature trends, economic losses, duration, impacts to reservoirs, etc.), defining which drought is the DOR for an area can be a complex issue. For much of the State, the DOR is generally considered to have occurred from 1950 through 1957. This drought combined severe reductions in rainfall with a multi-year duration, resulting in reduction or cessation of flows for many springs and streams, losses to livestock production and irrigated agriculture, and widespread impacts to vegetation. By the end of the drought in late 1956 or early 1957, nearly all of the counties in the State had been declared disaster areas. The drought of record for most water supplies used in Region C occurred from 1950 through 1957. The drought which began in 2011 and ended in early 2015 caused low inflows and low water levels for many Region C lakes. Analysis using hydrologic data from recent years has indicated that Jim Chapman (Cooper) Lake in the Sulphur River Basin has recently experienced a new drought of record. For other Region C supplies, the drought of the 1950s remains the drought of record.

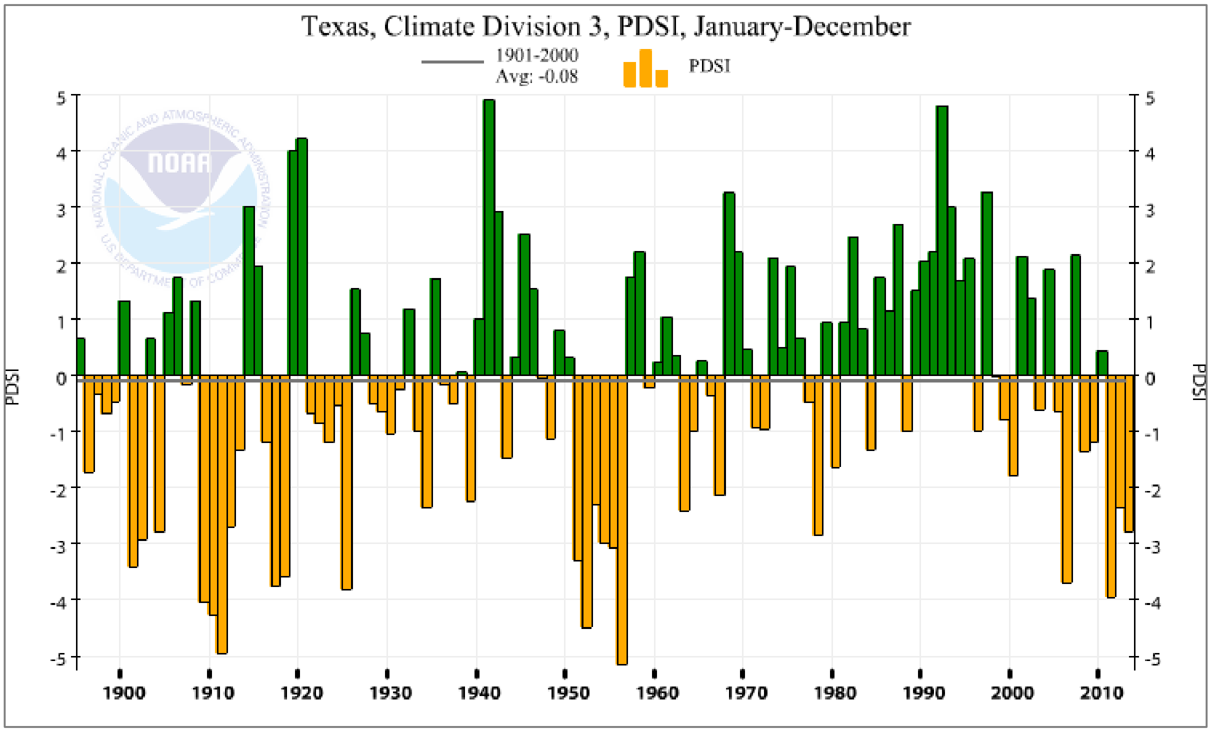
7.1.2 Surface Water Drought Indication

The significance of the drought for the Region can be illustrated in several ways. For reservoir supplies, which make up a large portion of the water supply for Region C, the DOR corresponds to the period that reaches the minimum storage in the reservoir under an assumed demand. While many of the major water supply reservoirs serving Region C were not yet constructed during the DOR, their performance under a repeat of historical hydrology including the DOR can be assessed using the Texas Commission on Environmental Quality (TCEQ) Water Availability Model (WAM); this assessment is directly associated with the use of the WAM model to determine firm availability of surface water.

7.1.3 Palmer Drought Severity Index

Another indicator commonly used by federal and state agencies to characterize drought severity is the Palmer Drought Severity Index (PDSI). The PDSI is an estimate of soil moisture conditions calculated based on precipitation and temperature. The PDSI classifies soil moisture on a scale ranging from approximately -6.0 to 6.0, with values of approximately -0.49 to 0.49 reflecting normal conditions and -4.0 or lower representing extreme drought. The annual PDSI for the North Central Texas area, which includes the majority of the population in Region C, is shown in Figure 7.1. As illustrated in the figure, the 1950s drought is among the most severe in terms of PDSI and is also prolonged.

Figure 7.1
Palmer Drought Severity Index for North Central Texas



7.1.4 Other Regional Droughts

The Region C area, like much of Texas, has experienced a number of droughts in addition to the DOR, including several more recent dry periods. The recent drought period which began in approximately year 2010-2011 resulted in extremely low rainfall and soil moisture and high temperatures, and created a new drought of record in some locations in the state.. In Region C this drought, while intense, has not extended as many years as the 1950's drought. Therefore, water supplies have yet to be impacted to the extent that would occur in a repeat of the DOR.

7.2 Current Preparations for Drought in Region C

7.2.1 Drought Contingency Planning Overview

The TCEQ, in accordance with the Texas Administrative Code (TAC), requires all wholesale public water suppliers, retail public water suppliers[1], irrigation districts, and applicants for new or amended water rights to prepare and submit to the TCEQ drought contingency plans (DCPs) meeting the requirements of 30 TAC §288(b) and to update these plans at least every five years. TCEQ administrative rules define a

[1] Retail public water suppliers serving fewer than 3,300 connections are not required to submit their DCPs to the TCEQ but must make their DCPs available upon request.

drought contingency plan as "a strategy or combination of strategies for temporary supply management and demand management responses to temporary and potentially recurring water supply shortages and other water supply emergencies". TCEQ rules and associated guidance documents for drought contingency planning embody several key principles including:

- Drought and its potential impacts on both water supply and demand, as well as water supply infrastructure, can be expected to occur;
- Drought response measures and implementation procedures can be defined in advance of drought;
- Through timely implementation of drought response measures, it is possible to avoid, minimize, or mitigate the risks and impacts of water shortages and other drought-related water supply emergencies;
- Some water demands are considered essential to public health and safety or to the economy while others can be considered non-essential or discretionary; and
- Drought contingency plans should be tailored to the unique circumstances of each water supplier (e.g., vulnerability of water supply and/or infrastructure to drought, end-users and demand characteristics, objectives, etc.).

Although each water supplier faces unique circumstances, there are a few elements that are found in most drought contingency plans and are consistent with the requirements for municipal DCPs in 30 TAC §288.20. These include:

- Criteria and procedures for determining when to initiate and when to terminate drought response measures. These are typically referred to as drought triggers. Common examples of drought triggers include indicators of supply availability (e.g., quantity of water supply remaining in a source) and demand indicators (e.g., daily demand relative to infrastructure capacity).
- Successive stages of drought response that require the implementation of increasingly stringent measures in response to increasingly severe drought conditions. A typical drought contingency plan will have an initial stage of voluntary measures followed by two or three successive stages of increasing stringent mandatory measures.
- Demand reduction goals or targets for each stage.
- Predetermined drought response measures for each stage that may include supply management, such as the temporary use of an alternative water source, and/or demand management, such as restrictions on non-essential water uses.
- Procedures for plan implementation and enforcement.
- Public information (e.g., notification) and education.

Most drought contingency plans place a heavy emphasis on demand management measures that are designed to reduce water demands by means of curtailment of certain uses. It is important to note that demand management in this context is distinctly different from water conservation, although the terms are often used interchangeably. The objective of water conservation is to achieve lasting, long-term reductions in water use through improved water use efficiency, reduced waste, and through reuse and recycling. By contrast, demand curtailment is focused on temporary reductions in water use in response to temporary and potentially recurring water supply shortages or other water supply emergencies (e.g., equipment failures caused by excessively high peak water demands). Common approaches to water demand curtailment, applied individually or in combination, include:

- Prescriptive restrictions or bans on non-essential water uses and waste. In a municipal setting, such restrictions commonly target landscape irrigation, car washing, ornamental fountains, etc.
- Use of water pricing strategies, such as excess use surcharges, to encourage compliance with water use restrictions or to penalize excessive water use.
- Water rationing, where water is allocated to users on some proportionate or pro rata basis.

7.2.2 Current Drought Preparation

All wholesale public water providers and most municipalities in Region C have made preparation for responding to drought conditions, including the development of individual drought contingency plans to be implemented when necessary.

7.2.3 Regional Coordination

In an effort to become more consistent across the region, the major Wholesale Water Providers (WWPs) and municipal suppliers held a series of meetings (2013-2014) to reach consensus on the number of stages in their DCPs and the primary outdoor irrigation restrictions. As a result of those meetings, most of the large WWPs (Dallas, Fort Worth, North Texas Municipal Water District, Tarrant Regional Water District and Upper Trinity Regional Water District) modified their DCPs to have three stages which included the following irrigation restrictions for the following stages.

- Stage 1 - Mandatory no more than twice per week watering (exception for hand watering, drip irrigation and soaker hoses).
- Stage 2 - Mandatory no more than once per week watering (exception for hand watering, drip irrigation and soaker hoses).
- Stage 3 - No outdoor irrigation (some exceptions for hand watering, drip irrigation and soaker hoses for trees and foundations).

7.2.4 Summary of Existing Triggers and Responses

As part of the effort associated with Task 7 of the RWP, the RCWPG performed an assessment of existing drought triggers and planned responses in the Region based on available DCPs. TCEQ rules and 30 TAC §288(b) require that DCPs include documentation of coordination with the RWPGs to ensure consistency with the regional plans. Additionally, information regarding drought contingency measures, identified demand reduction, history, and program cost was requested from WUGs as part of the Region C survey for the 2016 Regional Water Plan (RWP). The RCWPG was able to obtain DCPs for 98 entities in the Region, including named Water User Groups (WUGs), and retail suppliers within the County-Other WUGs.

A Region C drought contingency plan database was developed to store information on the available DCPs, including sponsor information, number of stages, and the trigger and response types associated with each stage. Each drought stage was also characterized by the reduction type (percent demand, unit reduction, etc.), and associated reduction quantity value (percentage, MGD, or other). The results of this analysis are summarized in the following table. Table 7.1 is organized by WWP since many of their customer's triggers are dependent on the WWP triggers.

Table 7.1
Summary of Existing DCPs for Region C

DWU and DWU Customers DCPs															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
DALLAS WATER UTILITIES	2/1/2014	WUG/WWP		Lake Ray Roberts, Lake Lewisville, Lake Grapevine, Elm Fork Channel of the Trinity River (above Frazier Dam), Lake Ray Hubbard, Lake Tawakoni, Lake Fork, Lake Palestine (unconnected), White Rock Lake, Return Flows into Lakes Lewisville, Ray Roberts and Ray Hubbard	3	• Either: (1) the total raw water supply in connected lakes (east and west); or, (2) the western lakes; or, (3) the eastern lakes has dropped below 65% (35% depleted) of DWU' s share of the total conservation storage of the lakes; or • Water demand has reached or exceeded 85% of delivery capacity for 4 consecutive days; or • Water demand approaches a reduced delivery capacity for all or part of the system, as determined by DWU; or • Water line breaks or pump /system failures, which impact the ability of DWU to provide treated water service; or • Natural or man-made contamination of the water supply source(s) occurs.	5%	• Either: 1) the total raw water supply in connected lakes (east and west); or, (2) the western lakes; or, (3) the eastern lakes has dropped below 50% (50% depleted) of DWU' s share of the total conservation storage of the lakes; or • Water demand has reached or exceeded 90% of delivery capacity for 3 consecutive days; or • Water demand equals a reduced delivery capacity for all or part of the system, as determined by DWU; or • Water line breaks or pump /system failures occur, which impact the ability of DWU to provide treated water service; or • Natural or man -made contamination of the water supply source(s) occurs.	15%	• Either: (1) the total raw water supply in connected lakes (east and west) or (2) the western lakes or (3) the eastern lakes has dropped below 30% (70% depleted) of DWU' s share of the total conservation storage; or • Water demand has reached or exceeded 95% of delivery capacity for 2 consecutive days; or • Water demand exceeds a reduced delivery capacity for all or part of the system, as determined by DWU; or • Water line breaks or pump /system failures occur, which impact the ability of DWU to provide treated water service; or • Natural or man -made contamination of the water supply source(s) occurs.	20%				
CARROLLTON	4/15/2014	WUG	DWU	DWU Sources	3	• DWU has initiated Stage 1	5%	• DWU has initiated Stage 2	15%	• DWU has initiated Stage 3	20%				
CEDAR HILL	11/25/2008	WUG	DWU	DWU Sources, Trinity Aquifer	3	• DWU has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Supply and Storage a. The City of Cedar Hill experiences three consecutive days of water pumping at 90% of water storage capacity. b. The City Manager or his/her designee determines that an emergency exists within the city's water system. Other a. Unforeseen situations that limit distribution of water, as determined by the Designated Official. b. Short or long term equipment failure, failure to maintain 35 psi at all points in the distribution system and a minimum of 20 psi under combined fire and drinking water flow conditions. c. Electrical power failures or restrictions.	1%	• DWU has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: Supply and Storage a. Combined ground storage levels fall below 50% of capacity at the beginning of any 24-hour period. b. The City of Cedar Hill experiences five (5) consecutive days of water pumping in excess of 100%. d. Stage 1 voluntary restrictions fail to alleviate continued potable water depletion. Other a. If there are long term shortages of water supply within a pressure district. b. Short or long term equipment failure, failure to maintain 35 psi at all points in the distribution system and a minimum of 20 psi under combined fire and drinking water flow conditions. c. Unforeseen situations that limit distribution of water as	5%	• DWU has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: Supply and Storage Other a. Any unanticipated situations that limit distribution of potable water. b. Electrical power failure or restrictions. c. Natural or man-made contamination of the water supply source(s).					

DWU and DWU Customers DCPs															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
CEDAR HILL, continued								determined by the City Manager or his/her designee. d. Electrical power failures or restrictions.							
COCKRELL HILL	4/1/2014	WUG	DWU	DWU Sources	3	• DWU has initiated Stage 1 The Cockrell Hill City Manager will publish written recommendations for the specific drought stage measures that should be enacted by the City Council for the current set of drought conditions, and the City Council may enact the Drought Stage and measures.	5%	• DWU has initiated Stage 2 The Cockrell Hill City Manager will publish written recommendations for the specific drought stage measures that should be enacted by the City Council for the current set of drought conditions, and the City Council may enact the Drought Stage and measures.	15%	• DWU has initiated Stage 3 The City Council may enact the Drought Stage and measures.	20%				
COPPELL	4/1/2009	WUG	DWU	DWU Sources	5	• DWU has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: 1) Short-term deficiencies in the City's distribution system limit supply capabilities.		• DWU has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: 1) Notification is received from DWU requiring implementation of like procedures by wholesale customers. 2) Water demands exceed ninety percent (90%) of the current maximum flow rate contracted with DWU for five (5) consecutive days. 3) Ground Storage Reservoir levels do not recover for two (2) consecutive days. 4) Short-term deficiencies m the City's distribution system limit supply capabilities.	average daily water demand ≤ 90% of maximum flow contracted from DWU	• DWU has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: 1) Notification is received from DWU requiring water demand reductions in accordance with contract obligations for wholesale customers. 2) Water demands exceed ninety-five percent (95%) of the current maximum flow rate contracted with DWU for five (5) consecutive days. 3) Short-term deficiencies in the City's distribution system, such as system outage due to the failure or damage of major water system components, limit supply capabilities. 4) Ground Storage Reservoir levels do not recover for three (3) consecutive days.	average daily water demand ≤ 95% of maximum flow contracted from DWU	These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: 1) Notification is received from DWU requiring water demand reductions in accordance with contract obligations for wholesale customers. 2) Water demands exceed 100 percent (100%) of the current maximum flow rate contracted with DWU for two (2) consecutive days. 3) Short term deficiencies in the City's distribution system, such as system outage due to the failure or damage of major water system components, limit supply capabilities. 4) Ground Storage reservoir levels do not recover for four (4) consecutive days.	average daily water demand ≤ 95% of maximum flow contracted from DWU	These triggers below are internal triggers which may cause the City to implement Stage 5 restrictions: 1) Any major water system component failure that causes the unprecedented loss of capability to provide water service. 2) Natural or man-made contamination of the water supply source(s).	As necessary
DENTON	4/25/2014	WUG	DWU	Lake Lewisville, Lake Ray Roberts, DWU Sources	3	• DWU has initiated Stage 1	5%	• DWU has initiated Stage 2	15%	• DWU has initiated Stage 3	20%				
FLOWER MOUND	4/5/2010	WUG	UTRWD DWU	UTRWD Sources, DWU Sources	4	• DWU has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: a. Either wholesale water supplier(s) implement restrictive measures that require customers to implement similar restrictions for reasons such as conserving reservoir levels, maintaining system pressures, water treatment capacity, or other such items requiring cooperation; or	1%	• DWU has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: a. Either average daily water demand reaches ninety percent (90%) of available supply for two (2) consecutive days; or b. Average daily water demand reaches ninety percent (90%) of the Town's water distribution system pumping capacity for two (2) consecutive days; or c. Failures occur with Town or wholesale supplier equipment	5%	• DWU has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: a. Either average daily water demand reaches ninety-five percent (95%) of available supply for two (2) consecutive days; or b. Average daily water demand reaches ninety-five percent (95%) of the Town's water distribution system pumping capacity for two (2) consecutive days; or	15%	These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: a. Either average daily water demand reaches ninety-eight percent (98%) of the Town's water distribution system pumping capacity for one (1) day; or b. The water system is contaminated either accidentally or intentionally; or c. Major waterline breaks, or pump or system failure occurs causing unprecedented loss of	25%		

DWU and DWU Customers DCPs															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
FLOWER MOUND, continued						b. Total water consumption reaches seventy-five percent (75%) of the Town's water distribution pumping capacity; or, c. The water supply system has a significant limitation due to failure of or damage to important system components.		or systems that result in a situation where demand reaches ninety percent (90%) of remaining supply or system capacity; or d. Wholesale suppliers implement restrictive measures that require customers to implement similar restrictions for reasons such as conserving reservoir levels, maintaining system pressures, water treatment capacity or other items requiring cooperation.		c. Failures occur with Town or wholesale supplier equipment or systems that result in a situation where demand reaches ninety-five percent (95%) of remaining supply or system capacity, or d. Wholesale suppliers implement restrictive measures that require customers to implement similar restrictions for reasons such as conserving reservoir levels, maintaining system pressures, water treatment capacity or other items requiring cooperation.		capacity to provide treated water service; or d. Wholesale suppliers implement restrictive measures that require customers to implement similar restrictions for reasons such as conserving reservoir levels, maintaining system pressures, water treatment capacity, or other items requiring cooperation.			
GRAND PRAIRIE	6/17/2014	WUG	DWU Fort Worth (TRWD) TRA	DWU Sources, TRWD Sources, Joe Pool Lake, Trinity Aquifer	3	• DWU has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Condition 1: Pursuant to requirements specified in the wholesale treated water purchase contracts with any wholesale water supplier, notification is received from such supplier requesting initiation of water restrictions. Condition 2: Combined storage fall below 200 gallons per capita at the beginning of a 24-hour demand period. Condition 3: Water demand exceeds ninety percent (90%) of the current maximum flow rate contracted with DWU for three (3) consecutive days. Condition 4: Other- situations that limit distribution of water, as determined by the Director such as: a. Short or long term equipment failure or failure to maintain 35-psi pressure at up to 500 service locations or up to 10 fire hydrants in localized areas. b. Short term deficiencies within an entire pressure district. c. Power failure or restrictions. d. Short term disruptions of major water supply lines.	5%	• DWU has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: Condition 1. Pursuant to requirements specified in the wholesale treated water purchase contract, notification is received from one or more wholesale supplier requesting water restrictions. Condition 2. Total water supply reduced by 10% on a continuous basis during high water usage months. Condition 3. Water use exceeds one hundred percent (100%) of the current maximum flow rate contracted from wholesale water suppliers for five consecutive days. Condition 4. Combined storage falls below 150 gallons per capita at the beginning of a 24-hour demand period. Condition 5. Failure to maintain 35 psi pressure in any pressure plane. Condition 6. Water use exceeds one hundred and three percent (103%) of the current maximum flow rate contracted from either wholesale water supplier for three (3) consecutive days. Condition 7. Short-term deficiencies in the City's distribution system limit supply capabilities, such as system outage due to the failure or damage of major water system components.	Average daily water demand ≤ 95% of the combined water from City wells and maximum flow contracted from DWU and Fort Worth	• DWU has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: Condition 1 Pursuant to requirements specified in the wholesale purchase contract, notification is received from either wholesale water supplier requesting initiation of water restrictions. Condition 2 Total water supply reduced by 20% on a continuous basis during high water usage months. Condition 3 Combined storage falls below 140 gallons per capita at the beginning of a 24-hour demand period. Condition 4 Stage 2 restrictions fail to alleviate continued potable water storage depletion Condition 5 Long term deficiencies in supply within and entire pressure district. Condition 6 Failure to maintain 35 psi pressure in any portion of the distribution system. Condition 7 Any unanticipated situations that limit distribution of water, as determined by the Director. Condition 8 Power failure or restrictions.	Average daily water demand ≤ 90% of the combined water from City wells and maximum flow contracted from DWU and Fort Worth				

DWU and DWU Customers DCPs																
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
IRVING	8/7/2014	WUG	DWU	Jim Chapman Lake, DWU Sources	3	• Condition 1: DWU has initiated Stage 1 • Condition 2: Water demand exceeds ninety percent (90%) of the combined current maximum wholesale flow rate contracted with DWU and from Irving Lake Chapman water supply for seven (7) consecutive days. • Condition 3: Irving's combined water storage account in Jim Chapman Lake and Lewisville Lake is less than 65 percent (65%) of Irving's total storage account capacity in Jim Chapman Lake. • Condition 4: Short-term deficiencies in the city's distribution system limit supply capabilities. • Condition 5: Supply source becomes contaminated. • Condition 6: As determined by the Director due to drought or reduced water supply.	3%	• Condition 1: DWU has initiated Stage 2. • Condition 2: Water use exceeds 100 percent (100%) of the combined current maximum wholesale flow rate contracted from DWU and Irving Lake Chapman water supply for five consecutive days. • Condition 3: Irving's combined water storage account in Jim Chapman Lake and Lewisville Lake is less than 45 percent (45%) of Irving's total storage account capacity in Jim Chapman Lake. • Condition 4: Short-term deficiencies in the city's distribution system limit supply capabilities, such as system outage due to the failure or damage of major water system components. • Condition 5: Inability to maintain or replenish adequate volumes of water in storage to provide for public health and safety. • Condition 6: Supply source becomes contaminated. • Condition 7: As determined by Director due to drought or reduced water supply.	8%	• Condition 1: DWU has initiated Stage 3. • Condition 2: Irving's combined water storage account in Jim Chapman Lake and Lewisville Lake is less than 20 percent (20%) of Irving's total storage account capacity in Jim Chapman Lake. • Condition 3: Short-term deficiencies in the city's distribution system limit supply capabilities, such as system outage due to the failure or damage of major water system components. • Condition 4: Inability to maintain or replenish adequate volumes of water in storage to provide for public health and safety. • Condition 5: Supply source becomes contaminated. • Condition 6: As determined by Director due to drought or reduced water supply.	20%				
LEWISVILLE	1/1/2014	WUG	DWU	DWU Sources	3	• DWU has initiated Stage 1 The conditions which can trigger implementation of demand management measures, include diminished Lewisville Lake pool elevations, depletion of potable water storage, and equipment failures which affect the ability of the system to maintain required water pressure.	1%	• DWU has initiated Stage 2 The conditions which can trigger implementation of demand management measures, include diminished Lewisville Lake pool elevations, depletion of potable water storage, and equipment failures which affect the ability of the system to maintain required water pressure.	3%	• DWU has initiated Stage 3 The conditions which can trigger implementation of demand management measures, include diminished Lewisville Lake pool elevations, depletion of potable water storage, and equipment failures which affect the ability of the system to maintain required water pressure.	5%				

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
NORTH TEXAS MUNICIPAL WATER DISTRICT	4/30/2014	WWP		Lake Lavon, Jim Chapman Lake, Lake Texoma, SRA Upper Sabine Basin (Lake Tawakoni, Lake Fork), Bonham Lake, East Fork Raw Water Supply Project (Wetland), DWU, Wilson Creek Reuse, Direct Reuse for Irrigation (Collin, Kaufman, Rockwall Counties)	3	• The Executive Director, with the concurrence of the NTMWD Board of Directors, finds that conditions warrant the declaration of Stage 1. • Water demand is projected to approach the limit of the permitted supply. • The storage level in Lavon Lake is less than 55 percent of the total conservation pool capacity. • NTMWD's storage in Jim Chapman Lake is less than 55 percent of the total conservation pool capacity. • The Sabine River Authority has indicated that its Upper Basin water supplies used by NTMWD (Lake Tawakoni and/or Lake Fork) are in a Mild drought. • NTMWD has concern that Lake Texoma, the East Fork Raw Water Supply Project, or some other NTMWD source may be limited in availability within the next 6 months. • Water demand exceeds 95 percent of the amount that can be delivered to Customers for three consecutive days. • Water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source is interrupted or unavailable due to contamination, invasive species, equipment failure or other cause. • Water supply system is unable to deliver water due to the failure or damage of major water system components.	5%	• The Executive Director, with the concurrence of the NTMWD Board of Directors, finds that conditions warrant the declaration of Stage 2. • Water demand is projected to approach the limit of the permitted supply. • The water storage in Lavon Lake is less than 45 percent of the total conservation pool capacity. • NTMWD's storage in Jim Chapman Lake is less than 45 percent of NTMWD's conservation pool capacity. • The Sabine River Authority has indicated that its Upper Basin water supplies used by NTMWD (Lake Tawakoni and/or Lake Fork) are in a Moderate drought. • NTMWD has concern that Lake Texoma, the East Fork Raw Water Supply Project, or some other NTMWD source may be limited in availability within the next 3 months. • Water demand exceeds 98 percent of the amount that can be delivered to Customers for three consecutive days. • Water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source is interrupted or unavailable due to contamination, invasive species, equipment failure or other cause. • Water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• The Executive Director, with the concurrence of the NTMWD Board of Directors, finds that conditions warrant the declaration of Stage 3. • Water demand is projected to approach or exceed the limit of the permitted supply. • The storage in Lavon Lake is less than 35 percent of the total conservation pool capacity. • NTMWD's storage in Jim Chapman Lake is less than 35 percent of NTMWD's total conservation pool capacity. • The Sabine River Authority has indicated that its Upper Basin water supplies used by NTMWD (Lake Tawakoni and/or Lake Fork) are in a Severe drought. (Measures required by SRA under a Severe drought designation are similar to those under NTMWD's Stage 3.) • The supply from Lake Texoma, the East Fork Raw Water Supply Project, or some other NTMWD source has become limited in availability. • Water demand exceeds the amount that can be delivered to Customers. • Water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source is interrupted or unavailable due to contamination, invasive species, equipment failure or other cause. • Water supply system is unable to deliver water due to the failure or damage of major water system components.	33%				

NTMWD and NTMWD Customers DCP																
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
ABLES SPRINGS WSC	5/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	As necessary				
ALLEN	5/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • The City's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • The City's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • The City's water supply source becomes contaminated. • The City's water supply system is unable to deliver water due to the failure or damage of major water system components. • The City is unable to recover water storage of 90 percent in all storage facilities within a twenty-four hour period.	5%	• The NTMWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • The City's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • The City's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • The City's water supply source becomes contaminated. • The City's water supply system is unable to deliver water due to the failure or damage of major water system components. • The City is unable to recover water storage of 75 percent in all storage facilities within a twenty-four hour period.	10%	• The NTMWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • The City's water demand exceeds the amount that can be delivered to customers. • The City's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • The City's water supply source becomes contaminated. • The City's water supply system is unable to deliver water due to the failure or damage of major water system components. • The City is unable to recover water storage of 50 percent in all storage facilities within a twenty-four hour period.	33%				

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
BONHAM	3/20/2014	WUG	NTMWD	Lake Bonham	5	• The NTMWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: 1. When the daily water demand equals or exceeds 2.5 million gallons for 7 consecutive days or 3. 0 million gallons on a single day. 2. Continually falling treated water reservoir levels which do not refill above 100 percent overnight (24 hour operation). 3. Short or long term equipment failure or failure to maintain 35 psi at up to 250 service locations or up to ten hydrants in a localized area. 4. Combined storage falls below 90% capacity at the beginning of a 24 -hour demand period.	10%	• The NTMWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: 1. If Stage I measures fail to alleviate the continued triggering conditions. 2. When the daily water demand equals or exceeds 2.5 million gallons for 14 consecutive days or 3. 0 million gallons on a single day. 3. Continually falling treated water reservoir levels which do not refill above 100 percent overnight. 4. Short or long term equipment failure or failure to maintain 35 psi at up to 500 service locations or up to fifteen hydrants in an area. 5. Combined storage falls below 80% of total capacity at the beginning of a 24 -hour demand period. 6. Failure to comply will result in citations being issued to violators.	15%	• The NTMWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: 1. If Stage II measures fail to alleviate the continued triggering conditions. 2. When the daily water demand equals or exceeds 3. 0 million gallons for 7 consecutive days or 3. 5 million gallons on a single day. 3. Continually falling treated water reservoir levels which do not refill above 95 percent overnight. 4. Combined storage falls below 70% of capacity at the beginning of a 24 -hour demand period. 5. Failure to comply will result in citations being issued to violators.	20%	These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: 1. If Stage III measures fail to alleviate the continued triggering conditions. 2. When the daily water demand equals or exceeds 3. 5 million gallons for 4 consecutive days or 4.0 million gallons on a single day. 3. Continually falling treated water reservoir levels, which do not refill above 90 percent overnight. 4. Combined storage falls below 65% of capacity at the beginning of a 24 -hour demand period. 5. Failure to comply will result in citations being issued to violators.	30%	These triggers below are internal triggers which may cause the City to implement Stage 5 restrictions: 1. Major water line breaks or pump system failures occur, which creates an unprecedented loss of capability to provide water service; 2. Power failure, which prevents the delivery of water to the water system. 3. A major equipment malfunction at the raw water pump station or at the treatment plant, which prevents the delivery of water to the water system. 4. Natural or man-made contamination of the water supply source. 5. Any other unanticipated situation that limits the distribution of treated water. 6. Failure to comply will result in citations being issued to violators.	
CASH SUD	2/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	As necessary				

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
COLLEGE MOUND WSC	4/1/2014	WUG	NTMWD Terrell (NTWMD)	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • College Mound SUD's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • College Mound SUD's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • College Mound SUD's water supply system is unable to deliver water due to the failure or damage of major water system components. • College Mound SUD's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • College Mound SUD's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • College Mound SUD's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • College Mound SUD's water supply system is unable to deliver water due to the failure or damage of major water system components. • College Mound SUD's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • College Mound SUD's water demand exceeds the amount that can be delivered to customers. • College Mound SUD's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • College Mound SUD's water supply system is unable to deliver water due to the failure or damage of major water system components. • College Mound SUD's individual plan may be implemented if other criteria dictate.	As necessary				
FARMERSVILLE	7/9/2013	WUG	NTMWD	NTMWD Sources	4	• NTMWD has initiated Stage 1. • City's water demand exceeds ninety (90) percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components.	2%	• The NTMWD has initiated Stage 2. • City's water demand exceeds ninety-five (95) percent of the amount that can be delivered to customers for three consecutive days. City's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components.	5%	• The NTMWD has initiated Stage 3. City's water demand exceeds ninety-eight (98) percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• The NTMWD has initiated Stage 4. • City's water demand exceeds the amount that can be delivered to customers. • City's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components.	As necessary		
FATE	5/18/2009	WUG	NTMWD	NTMWD Sources	4	•The NTMWD has initiated Stage 1 • City's water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major	2%	• The NTMWD has initiated Stage 2 • City's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major	5%	• The NTMWD has initiated Stage 3 • City's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major	10%	• The NTMWD has initiated Stage 4 • City's water demand exceeds the amount that can be delivered to customers. • City's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components.	As necessary		

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
FATE, continued						water system components. • City's individual plan may be implemented if other criteria dictate.		water system components. • City's individual plan may be implemented if other criteria dictate.		water system components. • City's individual plan may be implemented if other criteria dictate.		• City's individual plan may be implemented if other criteria dictate.			
FORNEY	6/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1• Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days.• Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate.• Supply source becomes contaminated.• Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components.• Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2• Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days.• Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate.• Supply source becomes contaminated.• Supply source is interrupted or unavailable due to invasive species.• Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components.• Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3• Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate.• Supply source becomes contaminated.• Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components.• Supplier's individual plan may be implemented if other criteria dictate.	As necessary				
FRISCO	4/28/2014	WUG	NTMWD	NTMWD Sources	4	• The NTMWD has initiated Stage 1	2%	• The NTMWD has initiated Stage 2	5%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 4 • NTMWD has imposed a reduction in water available to the City of Frisco.	As necessary		

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
GARLAND	3/20/2012	WUG	NTMWD	NTMWD Sources	4	• The NTMWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: (i) The City's wholesale water provider, North Texas Municipal Water District (NTMWD), notifies the director of delivery or source shortages, requests initiation of stage 1 of the plan, and the director concurs; (ii) Total daily water demand equals 90 percent of the amount that can be delivered to customers for three consecutive days; (iii) Water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate; (iv) Supply source becomes contaminated; (v) Water system is unable to deliver water due to the failure or damage of major water system components; or (vi) The water system experiences continually falling treated water reservoir levels that do not refill above 80 percent overnight.	2%	• The NTMWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: (i) The City's wholesale water provider, NTMWD, notifies the director of delivery or source shortages, requests initiation of stage 2 of the plan, and the director concurs; (ii) Total daily water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days; (iii) Water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate; (iv) Supply source becomes contaminated; (v) Water system is unable to deliver water due to the failure or damage of major water system components; or (vi) The water system experiences continually falling treated water reservoir levels that do not refill above 65 percent overnight.	5%	• The NTMWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: (i) The City's wholesale water provider, NTMWD, notifies the director of delivery or source shortages, requests initiation of stage 3 of the plan, and the director concurs; (ii) Total daily water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days; (iii) Water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate; (iv) Supply source becomes contaminated; (v) Water system is unable to deliver water due to the failure or damage of major water system components; or (vi) Continually falling treated water reservoir levels that do not refill above 50 percent overnight are experienced.	10%	(i) The City's wholesale water provider, NTMWD, notifies the director of delivery or source shortages, requests initiation of stage 4 of the plan, and the director concurs; (ii) Total daily water demand exceeds the amount that can be delivered to customers; (iii) Water demand for all or part of the delivery system seriously exceeds delivery capacity because delivery capacity is inadequate; (iv) Supply source becomes contaminated; (v) Water supply system is unable to deliver water due to the failure or damage of major water system components; or (vi) The water system experiences continually falling treated water reservoir levels that do not refill above 20 percent overnight.	As necessary		
KAUFMAN	9/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	As necessary				

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
LITTLE ELM	5/17/2011	WUG	NTMWD	NTMWD Sources Woodbine Aquifer	4	• The NTMWD has initiated Stage 1 • Town of Little Elm's water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days. • Town of Little Elm's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Town of Little Elm's water supply system is unable to deliver water due to the failure or damage of major water system components. • Town of Little Elm's individual plan may be implemented if other criteria dictate.	2%	• The NTMWD has initiated Stage 2 • Town of Little Elm's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Town of Little Elm's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Town of Little Elm's water supply system is unable to deliver water due to the failure or damage of major water system components. • Town of Little Elm's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 3 • Town of Little Elm's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Town of Little Elm's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Town of Little Elm's water supply system is unable to deliver water due to the failure or damage of major water system components. • Town of Little Elm's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 4 • Town of Little Elm's water demand exceeds the amount that can be delivered to customers. • Town of Little Elm's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Town of Little Elm's water supply system is unable to deliver water due to the failure or damage of major water system components. • Town of Little Elm's individual plan may be implemented if other criteria dictate.	As necessary		
MCKINNEY	4/15/2014	WUG	NTMWD	NTMWD Sources	3	• The city manager may implement any action required by NTMWD. In addition, the city manager may order the implementation of any of the actions set forth in the stage 1 policy, as adopted by the city council by resolution. o Updated and maintained in the Code of Ordinances Chapter 110 Article VI	5%	• The city manager may implement any action required by NTMWD. In addition, the city manager may order the implementation of any of the actions set forth in the stage 2 policy, as adopted by the city council by resolution. o Updated and maintained in the Code of Ordinances Chapter 110 Article VI	10%	• The city manager may implement any action required by NTMWD. In addition, the city manager may order the implementation of any of the actions set forth in the stage 3 policy, as adopted by the city council by resolution. o Updated and maintained in the Code of Ordinances Chapter 110 Article VI	As necessary				
MELISSA	4/22/2014	WUG	NTMWD GTUA	NTMWD Sources Lake Texoma Woodbine Aquifer	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	As necessary				

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
MESQUITE	4/21/2014	WUG	NTMWD	NTMWD Sources	4	1. The NTMWD has initiated Stage 1 2. The City's total water demand exceeds 85 percent of the amount that can be delivered to customers for three consecutive days; 3. The City's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate; 4. The City's supply source becomes contaminated; 5. The City's water supply system is unable to deliver water due to the failure or damage of major water system components; or 6. The City's water system experiences continually falling treated water levels that do not refill above 90 percent overnight for seven consecutive days; 7. The City's water system experiences overhead water storage levels incapable of filling above 90 percent for three consecutive days.	2%	1. NTMWD has initiated Stage 2 2. The City's total daily water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days; 3. The City's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate; 4. The City's supply source becomes contaminated; 5. The City's water system is unable to deliver water due to the failure or damage of major water system components; or 6. The City's water system experiences continually falling treated water levels that do not refill above 80 percent overnight for seven consecutive days. 7. The City's water system experiences overhead water storage levels incapable of filling above 80 percent for three consecutive days.	5%	1. NTMWD has initiated Stage 3 2. The City's total daily water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days; 3. The City's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate; 4. The City's supply source becomes contaminated; 5. The City's water system is unable to deliver water due to the failure or damage of major water system components; or 6. The City's water system experiences continually falling treated water levels that do not refill above 65 percent overnight for three consecutive days; 7. The City's water system experiences overhead water storage levels that do not refill above 65 percent for three consecutive days.	10%	1. NTMWD has initiated Stage 4 2. The City's total daily water demand exceeds the amount that can be delivered to customers. 3. The City's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate; 4. The City's supply source becomes contaminated; 5. The City's water supply system is unable to deliver water due to the failure or damage of major water system components 6. The City's water system experiences continually falling treated water levels not allowing ground and overhead storage to refill above 40 percent overnight for two consecutive days.	As necessary		
MURPHY	3/1/2011	WUG	NTMWD	NTMWD Sources	4	•The NTMWD has initiated Stage 1 • City's water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components. • City's individual plan may be implemented if other criteria dictate.	2%	• The NTMWD has initiated Stage 2 • City's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components. • City's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 3 • City's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components. • City's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 4 • City's water demand exceeds the amount that can be delivered to customers. • City's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components. • City's individual plan may be implemented if other criteria dictate.	As necessary		

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
NEVADA	5/1/2014	WUG	Nevada WSC (NTMWD)	NTMWD Sources	4	• NTMWD has initiated Stage 1. • NWSC's water demand exceeds ninety (90) percent of the amount that can be delivered to customers for three consecutive days. • NWSC'S water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • NWSC's water supply system is unable to deliver water due to the failure or damage of major water system components.	2%	• The NTMWD has initiated Stage 2. • NWSC's water demand exceeds ninety-five (95) percent of the amount that can be delivered to customers for three consecutive days. NWSC's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • NWSC's water supply system is unable to deliver water due to the failure or damage of major water system components. • NWSC individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 3. NWSC's water demand exceeds ninety-eight (98) percent of the amount that can be delivered to customers for three consecutive days. • NWSC's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • NWSC's water supply system is unable to deliver water due to the failure or damage of major water system components. • NWSC's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 4. • NWSC's water demand exceeds the amount that can be delivered to customers. • NWSC's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • NWSC's water supply system is unable to deliver water due to the failure or damage of major water system components. • NWSC individual plan may be implemented if other criteria dictate.	As necessary		
PLANO	4/28/2014	WUG	NTMWD	NTMWD Sources	4	•The NTMWD has initiated Stage 1• City's water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days.• City's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate.• Supply source becomes contaminated.• City's water supply system is unable to deliver water due to the failure or damage of major water system components.• City's individual plan may be implemented if other criteria dictate.	2%	• The NTMWD has initiated Stage 2• City's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days.• City's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate.• Supply source becomes contaminated.• City's water supply system is unable to deliver water due to the failure or damage of major water system components.• City's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 3• City's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days.• City's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate.• Supply source becomes contaminated.• City's water supply system is unable to deliver water due to the failure or damage of major water system components.• City's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 4• City's water demand exceeds the amount that can be delivered to customers.• City's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate.• Supply source becomes contaminated.• City's water supply system is unable to deliver water due to the failure or damage of major water system components.• City is unable to recover water storage of one hundred (100) percent in all storage facilities within a twenty-four (24) hour period.• City's individual plan may be implemented if other criteria dictate.	As necessary		

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
PRINCETON	2/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	As necessary				
PROSPER	5/27/2014	WUG	NTMWD	NTMWD Sources	4	•The NTMWD has initiated Stage 1 • Town's water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days. • Town's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Town's water supply system is unable to deliver water due to the failure or damage of major water system components. • Town's individual plan may be implemented if other criteria dictate.	2%	• The NTMWD has initiated Stage 2 • Town's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Town's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Town's water supply system is unable to deliver water due to the failure or damage of major water system components. • Town's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 3 • Town's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Town's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Town's water supply system is unable to deliver water due to the failure or damage of major water system components. • Town's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 4 • Town's water demand exceeds the amount that can be delivered to customers. • Town's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Town's water supply system is unable to deliver water due to the failure or damage of major water system components. • Town's individual plan may be implemented if other criteria dictate.	As necessary		
RICHARDSON	5/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 o City Manager may impose other conditions that may warrant the initiation of Stage 1.	5%	• The NTMWD has initiated Stage 2 o City Manager may impose other conditions that may warrant the initiation of Stage 2.	10%	• The NTMWD has initiated Stage 3 o City Manager or designee may impose other conditions that may warrant the initiation of Stage 3.	As necessary				

NTMWD and NTMWD Customers DCP															
						Stage 1		**Stage 2**		**Stage 3**		**Stage 4**		**Stage 5**	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
ROCKWALL	9/2/2014	WUG	NTMWD	NTMWD Sources	4	• The NTMWD has initiated Stage 1 • City's water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components. • City's individual plan may be implemented if other criteria dictate.	2%	• The NTMWD has initiated Stage 2 • City's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components. • City's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 3 • City's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components. • City's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 4 • City's water demand exceeds the amount that can be delivered to customers. • City's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • City's water supply system is unable to deliver water due to the failure or damage of major water system components. • City's individual plan may be implemented if other criteria dictate.	As necessary		
ROSE HILL SUD	4/22/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	As necessary				
ROWLETT	2/24/2012	WUG	NTMWD	NTMWD Sources	4	• The NTMWD has initiated Stage 1	2%	• The NTMWD has initiated Stage 2	5%	• The NTMWD has initiated Stage 3	10%	• The NTMWD has initiated Stage 4	As necessary		

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
ROYSE CITY	4/22/2014	WUG	NTMWD	NTMWD Sources	4	• The NTMWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: a. By April 30 of each year the director of public works shall forecast water supply and potential water demands for May 1 through September 30 of that year. The forecast will be based on supply information from North Texas Municipal Water District and from city pumping reports. b. Stage 1 may be initiated by the city manager for any other unforeseen threatening condition to the city's water system, or its ability to provide service to any and all service areas. c. Stage 1 may be initiated by the city manager if the city's water supplier requests in writing that stage 1 be initiated to conserve water regionally or for any other reason threatening the city's regular water supply and/or distribution capabilities.	2%	• The NTMWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: a. The city's inability to recover water storage to approximately 90 percent in all storage facilities within a 24-hour period. b. Stage 2 may be initiated by the city manager for any other unforeseen threatening condition to the city's water system, or its ability to provide service to any and all service areas. c. Stage 2 may be initiated by the city manager if the city's water supplier requests in writing that stage 2 be initiated to conserve water regionally or for any other reason threatening the city's regular water supply and/or distribution capabilities.	5%	• The NTMWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: a. The city's inability to recover water storage to approximately 90 percent in all storage facilities within a 48-hour period. b. Stage 3 may be initiated by the city manager for any other unforeseen threatening condition to the city's water system, or its ability to provide service to any and all service areas. c. Stage 3 may be initiated by the city manager if the city's water supplier requests in writing that stage 3 be initiated to conserve water regionally or for any other reason threatening the city's regular water supply and/or distribution capabilities.	10%	a. Catastrophically decreasing reservoir levels and/or delivery capabilities with inability to recover water storage to provide services necessary to public health, safety and welfare. b. Natural disasters (tornadoes, floods, brush fires, hurricanes, high winds). c. Water system failures (pressure zone deficiencies, chemical spills, broken water mains, electrical failure, failure of storage tanks or other equipment, pump station breakdown, water contamination). d. Stage 4 may be initiated by the city manager for any other unforeseen threatening condition to the city's water system, or its ability to provide service to any and all service areas. e. Stage 4 may be initiated by the city manager if the city water supplier request in writing that stage 4 be initiated, or for any other unforeseen threatening condition to the city's water system, or its ability to provide service to any and all service areas.	As necessary		
SACHSE	4/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	As necessary				

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
SEIS LAGOS UD	4/1/2014	WUG	NTMWD	NTMWD Sources	4	The NTMWD has initiated Stage 1• Supplier's water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days.• Supplier's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate.• Supply source becomes contaminated.• Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components.• Supplier's individual plan may be implemented if other criteria dictate.	2%	• The NTMWD has initiated Stage 2• Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days.• Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate.• Supply source becomes contaminated.• Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components.• Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 3• Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days.• Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate.• Supply source becomes contaminated.• Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components.• Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 4• Supplier's water demand exceeds the amount that can be delivered to customers.• Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate.• Supply source becomes contaminated.• Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components.• Supplier's individual plan may be implemented if other criteria dictate.	As necessary		
TERRELL	4/15/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Conditions are such that implementation of Stage 1 is desirable.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Conditions are such that implementation of Stage 2 is desirable.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Conditions are such that implementation of Stage 3 is desirable.	As necessary				

NTMWD and NTMWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
WYLIE	4/1/2014	WUG	NTMWD	NTMWD Sources	3	• The NTMWD has initiated Stage 1 • Supplier's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	5%	• The NTMWD has initiated Stage 2 • Supplier's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Supplier's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Supply source is interrupted or unavailable due to invasive species. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	10%	• The NTMWD has initiated Stage 3 • Supplier's water demand exceeds the amount that can be delivered to customers. • Supplier's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate. • Supply source becomes contaminated. • Supplier's water supply system is unable to deliver water due to the failure or damage of major water system components. • Supplier's individual plan may be implemented if other criteria dictate.	As necessary				

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
TARRANT REGIONAL WATER DISTRICT	5/20/2014	WWP		Lake Bridgeport, Eagle Mountain Lake, Lake Worth, Lake Benbrook, Lake Arlington, Richland-Chambers Lake, Cedar Creek Lake, Richland-Chambers Reuse (Wetlands)	3	• Total combined raw water supply in TRWD western and eastern division reservoirs drops below 75% (25% depleted) of conservation storage capacity. • Water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • One or more of TRWD's water supply sources has become limited in availability. • Water demand is projected to approach the limit of permitted supply. • Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • The General Manager finds that conditions warrant the declaration of a Stage 1 drought.	5%	• Total raw water supply in TRWD western and eastern division reservoirs drops below 60% (40% depleted) of conservation storage capacity. • Water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • One or more of TRWD's water supply sources has become limited in availability. • Water demand is projected to approach the limit of permitted supply. • Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • The General Manager finds that conditions warrant the declaration of a Stage 2 drought.	10%	• Total raw water supply in TRWD western and eastern division reservoirs drops below 45% (55% depleted) of conservation storage capacity. • Water demand exceeds the amount that can be delivered to customers. • Water demand for all or part of the TRWD delivery system approaches delivery capacity because delivery capacity is inadequate. • One or more of TRWD's water supply sources has become limited in availability. • Water demand is projected to approach the limit of permitted supply. • Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • The General Manager finds that conditions warrant the declaration of a Stage 3 drought.	20%				
ALEDO	5/1/2014	WUG	Fort Worth (TRWD)	TRWD Sources Trinity Aquifer	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • The City of Aledo's water demand reaches or exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • City of Aledo water treatment or distribution system becomes contaminated. • City of Aledo's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • City of Aledo's water supply system is unable to deliver water due to the failure or damage of major water system components.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • Water demand reaches or exceeds 95% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • City of Aledo's water distribution becomes contaminated. • City of Aledo's water demand for all or part of the delivery system equals or exceeds delivery capacity because delivery capacity is inadequate. • Water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • Water demand reaches or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. • City of Aledo's water distribution system becomes contaminated. • City of Aledo's water demand for all or part of the delivery system equals or exceeds delivery capacity because delivery capacity is inadequate. • Aledo's supply system is unable to deliver water due to the failure or damage of major water system components.	20%				

TRWD and TRWD Customers DCP																
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	
AZLE	4/1/2014	WUG	TRWD	Eagle Mountain Lake	3	• TRWD has initiated Stage 1 • Water demand is projected to approach the limit of permitted supply. • Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • The City Manager, with concurrence of the City Council, finds that conditions warrant the declaration of a Stage 1 drought.	5%	• TRWD has initiated Stage 2 • Water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Water demand is projected to approach the limit of permitted supply. • Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • The City Manager, with concurrence of the City Council, finds that conditions warrant the declaration of a Stage 2 drought	10%	• TRWD has initiated Stage 3 • Water demand exceeds the amount that can be delivered to customers • Water demand for all or part of the Azle delivery system approaches delivery capacity because delivery capacity is inadequate. •Water demand is projected to approach the limit of permitted supply. • Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • The City Manager, with concurrence of the City Council, finds that conditions warrant the declaration of a Stage 3 drought	20%					
BEDFORD	7/1/2014	WUG	TRA (TRWD)	TRWD Sources Trinity Aquifer	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • The City of Bedford water demand exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • The City of Bedford water treatment or distribution system becomes contaminated. • The City of Bedford water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • The City of Bedford water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • The City of Bedford water demand exceeds 95% of reliable delivery capacity for two consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • The City of Bedford demand for all or part of the delivery system equals or exceeds delivery capacity because delivery capacity is inadequate. • The City of Bedford water treatment of distribution system becomes contaminated. • The City of Bedford water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • The City of Bedford water demand exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. • The City of Bedford demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • The City of Bedford water treatment or distribution system becomes contaminated. • The City of Bedford water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	20%					

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
BENBROOK	5/1/2014	WUG	TRWD	Benbrook Lake Trinity Aquifer	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause BWA to implement Stage 1 restrictions: •BWA water demand exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. •BWA water treatment or distribution system becomes contaminated. •BWA water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. •BWA water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause BWA to implement Stage 2 restrictions: • BWA water demand exceeds 95% of reliable delivery capacity for two consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • BWA demand for all or part of the delivery system equals or exceeds delivery capacity because delivery capacity is inadequate. • BWA water treatment or distribution system becomes contaminated. • BWA water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause BWA to implement Stage 3 restrictions: • The BWA water demand exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. • The BWA demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • The BWA water treatment or distribution system becomes contaminated. • The BWA water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	20%				
BETHESDA WSC	4/15/2014	WUG	Fort Worth (TRWD)	TRWD Sources Trinity Aquifer	3	"• TRWD/Fort Worth has initiated Stage 1 These triggers below are internal triggers which may cause the WSC to implement Stage 1 restrictions: • Water consumption has reached 90 percent of the daily maximum supply for three (3) consecutive days. • There is an extended period (at least eight (8) weeks) of low rainfall and daily use has risen 20 percent above the use for the same period during the previous year."	5%	"• TRWD/Fort Worth has initiated Stage 2 These triggers below are internal triggers which may cause the WSC to implement Stage 2 restrictions: • Water consumption has reached 95 percent of the amount available for three (3) consecutive days. • The water level in any of the water storage tanks cannot be replenished for three (3) consecutive days."	10%	"• TRWD/Fort Worth has initiated Stage 3 These triggers below are internal triggers which may cause the WSC to implement Stage 3 restrictions: • Failure of a major component of the system or an event which reduces the minimum residual pressure in the system below 20 psi for a period of24 hours or longer. • Water consumption of98 percent or more of the maximum available for three (3) consecutive days. • Water consumption of 1 00 percent of the maximum available and the water storage levels in the system drop during one 24-hour period. • Natural or man-made contamination of the water supply source(s). • The declaration of a state of disaster due to drought condition in a county or counties served by the Corporation. • Other unforeseen events which could cause imminent health or safety risks to the public."	As necessary				

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
BRIDGEPORT	5/1/2014	WUG	TRWD	Lake Bridgeport	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • Bridgeport's water demand reaches or exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • Bridgeport's water supply sources or water distribution system becomes contaminated. • Bridgeport's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Bridgeport's water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • Bridgeport's water demand reaches or exceeds 95% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • Bridgeport's water supply sources or water distribution system becomes contaminated. • Bridgeport's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Bridgeport's water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • Bridgeport's water demand has reaches or exceeds 100% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. • Bridgeport's water supply sources or water distribution system becomes contaminated. • Bridgeport's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Bridgeport's water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	20%				
COLLEYVILLE	1/20/2015	WUG	TRA (TRWD)	TRWD Sources Private water wells	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Distribution limitations; demand projected to approach permitted limit;	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: Distribution limitations; demand projected to approach permitted limit	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: Major water production or distribution system limitations; natural or man-made contamination of the supply source; system outage due to failure of major water system components	20%				
CROWLEY	4/1/2014	WUG	Fort Worth (TRWD)	TRWD Sources Trinity Aquifer	3	• TRWD has initiated Stage 1	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • One or more sectors of the City are at 95% of reliable supply and have experienced three (3) consecutive days of temperature highs of more than 100 degrees with no rain. • The water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • Water demand has reached or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be City wide or in a specified sector of the system. • Contamination of the water supply source(s) or water supply system. • Demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Water supply system is unable to deliver water due to the	20%				

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
CROWLEY, continued										failure or damage of major water system components.					
DECATUR	3/1/2011	WUG	Wise County WSD (TRWD)	Lake Bridgeport	4	Annually, beginning on May 1 through September 30.	10%	These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: a. TRWD has initiated Stage 1. b. When the total daily water demand equals or exceeds 1.8 million gallons 3 consecutive days or 2.2 million gallons on a single day. c. Continually falling treated water reservoir levels which do not refill above 95% percent overnight (e.g., bases on an evaluation of minimum treated water storage required to avoid system outage).	15%	These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: 1. TRWD has initiated Stage 2 2. When the total daily water demand equals or exceeds 2.2 million gallons for 3 consecutive days or 2.4 million gallons on a single day. 3. Continually falling treated water reservoir levels which do not refill above 85% percent overnight (e.g., based on an evaluation of minimum treated water storage required to avoid system outage).	25%	These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: 1. TRWD has initiated Stage 3 2. When total daily water demands equals or exceeds 2.4 million gallons for 7 consecutive days. 3. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. 4. Natural or man-made contamination of the water supply source(s). 5. Continually falling treated water reservoir levels which do not refill above 75% percent overnight (e.g., based on an evaluation of minimum treated water storage required to avoid system outage).	50%		
EAST CEDAR CREEK FWSD	1/16/2013	WUG	TRWD	Cedar Creek Reservoir	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause ECCFWSD to implement Stage 1 restrictions: • ECCFWSD's water demand reaches or exceeds 85% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • ECCFWSD's water supply sources or water distribution system becomes contaminated. • ECCFWSD's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • ECCFWSD's water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause ECCFWSD to implement Stage 2 restrictions: • ECCFWSD's water demand reaches or exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • ECCFWSD's water supply sources or water distribution system becomes contaminated. • ECCFWSD's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • ECCFWSD's water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause ECCFWSD to implement Stage 3 restrictions: • ECCFWSD's water demand has reaches or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. • ECCFWSD's water supply sources or water distribution system becomes contaminated. • ECCFWSD's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • ECCFWSD's water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as energy shortages or outages.	20%				

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
EULESS	4/22/2014	WUG	TRA (TRWD)	TRWD Sources Trinity Aquifer	3	1. TRWD has initiated Stage 1 2. Water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. 3. Water demand is projected to approach the limit of permitted supply. 4. Supply source becomes contaminated. 5. Water supply system is unable to deliver water due to the failure or damage of major water system components. 6. The City Manager, or his/her designee, with concurrence of TRA, finds that conditions warrant the declaration of a Stage 1 drought.	5%	1. TRWD has initiated Stage 2 2. Water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. 3. Water demand is projected to approach the limit of permitted supply. 4. Supply source becomes contaminated. 5. Water supply system is unable to deliver water due to the failure or damage of major water system components. 6. The City Manager, with concurrence of the TRA, finds that conditions warrant the declaration of a Stage 2 drought.	10%	1. TRWD has initiated Stage 3 2. Water demand exceeds the amount that can be delivered to customers. 3. Water demand is projected to approach the limit of permitted supply. 4. Supply source becomes contaminated. 5. Water supply system is unable to deliver water due to the failure or damage of major water system components. 6. The City Manager, with concurrence of the TRA, finds that conditions warrant the declaration of a Stage 3 drought.	20%				
FOREST HILL	10/21/2014	WUG	Fort Worth (TRWD)	TRWD Sources	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • Fort Worth's water supply system is unable to deliver water due to the failure or damage of major water system components and has affected the City of Forest Hill's water supply.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • Water demand reaches or exceeds 95% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • Contamination of the water supply source(s) or water supply system. • Demand for all or part of the delivery system equals or exceeds delivery capacity because deliver capacity is inadequate from the City of Fort Worth. • Water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • Water demand has reached or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. • Contamination of the water supply source(s) or water supply system. • Demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Water supply system in unable to deliver water due to the failure or damage of major water system components.	20%				
FORT WORTH	5/1/2014	WUG	TRWD	TRWD Sources	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: o Water demand reaches or exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. o Fort Worth's water treatment or distribution system becomes contaminated. o Fort Worth's water demand for all or part of the delivery	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: o Water demand reaches or exceeds 95% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. o Contamination of the water supply source(s) or water supply system. o Demand for all or part of the delivery system equals or	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: o Water demand has reached or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. o Contamination of the water supply source(s) or water supply system. o Demand for all or part of the delivery system exceeds	20%				

TRWD and TRWD Customers DCP																
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
FORT WORTH, continued						system approaches delivery capacity because delivery capacity is inadequate. o Fort Worth's water supply system is unable to deliver water due to the failure or damage of major water system components.		exceeds delivery capacity because delivery capacity is inadequate. o Water supply system is unable to deliver water due to the failure or damage of major water system components.		delivery capacity because delivery capacity is inadequate. o Water supply system is unable to deliver water due to the failure or damage of major water system components.					
GRAND PRAIRIE	6/17/2014	WUG	DWU Fort Worth (TRWD) TRA	DWU Sources TRWD Sources Joe Pool Lake Trinity Aquifer	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Condition 1: Pursuant to requirements specified in the wholesale treated water purchase contracts with any wholesale water supplier, notification is received from such supplier requesting initiation of water restrictions. Condition 2: Combined storage fall below 200 gallons per capita at the beginning of a 24-hour demand period. Condition 3: Water demand exceeds ninety percent (90%) of the current maximum flow rate contracted with DWU for three (3) consecutive days. Condition 4: Other- situations that limit distribution of water, as determined by the Director such as: a. Short or long term equipment failure or failure to maintain 35-psi pressure at up to 500 service locations or up to 10 fire hydrants in localized areas. b. Short term deficiencies within an entire pressure district. c. Power failure or restrictions. d. Short term disruptions of major water supply lines.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: Condition 1. Pursuant to requirements specified in the wholesale treated water purchase contract, notification is received from one or more wholesale supplier requesting water restrictions. Condition 2. Total water supply reduced by 10% on a continuous basis during high water usage months. Condition 3. Water use exceeds one hundred percent (100%) of the current maximum flow rate contracted from wholesale water suppliers for five consecutive days. Condition 4. Combined storage falls below 150 gallons per capita at the beginning of a 24-hour demand period. Condition 5. Failure to maintain 35 psi pressure in any pressure plane. Condition 6. Water use exceeds one hundred and three percent (103%) of the current maximum flow rate contracted from either wholesale water supplier for three (3) consecutive days. Condition 7. Short-term deficiencies in the City's distribution system limit supply capabilities, such as system outage due to the failure or damage of major water system components.	Average daily water demand ≤ 95% of the combined water from City wells and maximum flow contracted from DWU and Fort Worth	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: Condition 1 Pursuant to requirements specified in the wholesale purchase contract, notification is received from either wholesale water supplier requesting initiation of water restrictions. Condition 2 Total water supply reduced by 20% on a continuous basis during high water usage months. Condition 3 Combined storage falls below 140 gallons per capita at the beginning of a 24-hour demand period. Condition 4 Stage 2 restrictions fail to alleviate continued potable water storage depletion Condition 5 Long term deficiencies in supply within and entire pressure district. Condition 6 Failure to maintain 35 psi pressure in any portion of the distribution system. Condition 7 Any unanticipated situations that limit distribution of water, as determined by the Director. Condition 8 Power failure or restrictions.	Average daily water demand ≤ 90% of the combined water from City wells and maximum flow contracted from DWU and Fort Worth				

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
HURST	6/1/2014	WUG	Fort Worth (TRWD)	TRWD Sources Trinity Aquifer	3	• TRWD/Fort Worth has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: o Water demands reach or exceed 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. o Hurst's water distribution system becomes contaminated. o Hurst's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. o Hurst's water supply system is unable to deliver water due to the failure or damage of major water system components, or due to other criteria, such as power outages or restrictions.	5%	• TRWD/Fort Worth has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • Water demand reaches or exceeds 95% of reliable delivery capacity for three consecutive days. The delivery capacity could be city wide or in a specified portion of the system. • Contamination of the water supply source(s) or water supply system. • Demand for all or part of the delivery system equals or exceeds delivery capacity because delivery capacity is inadequate. • Water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• TRWD/Fort Worth has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • Water demand has reached or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. • Contamination of the water supply source(s) or water supply system. • Demand for all or part of the water system exceeds delivery capacity because delivery capacity is inadequate. • Water supply system is unable to deliver water due to the failure or damage of major water system components	20%				
KELLER	6/17/2014	WUG	Fort Worth (TRWD)	TRWD Sources	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • Keller's water demand reaches or exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • Keller's water supply sources or water distribution system becomes contaminated. • Keller's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Keller's water supply system is unable to deliver water due to the failure or damage of major water system components.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • Keller's water demand reaches or exceeds 95% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. • Keller's water supply sources or water distribution system becomes contaminated. • Keller's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Keller's water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • Keller's water demand has reaches or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. • Keller's water supply sources or water distribution system becomes contaminated. • Keller's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Keller's water supply system is unable to deliver water due to the failure or damage of major water system components.	20%				

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
LAKE WORTH	4/14/2014	WUG	Fort Worth (TRWD)	TRWD Sources Trinity Aquifer	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Water demand reaches or exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. Lake Worth' s water distribution system becomes contaminated. Lake Worth' s water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. Lake Worth' s water supply system is unable to deliver water due to the failure or damage of major water system components.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: Water demand reaches or exceeds 95% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. Contamination of the water supply source(s) or water supply system. Demand for all or part of the delivery system equals or exceeds delivery capacity because delivery capacity is inadequate. Water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: Water demand has reaches or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. Contamination of the water supply source(s) or water supply system. Demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. Water supply system is unable to deliver water due to the failure or damage of major water system components.	20%				
MABANK	5/1/2009	WUG	TRWD	Cedar Creek Reservoir	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Triggering Conditions (City of Mabank) • Average daily water consumption reaches 85% of production capacity. Production capacity is defined as on line capacity in case of failure of a pump or facility, which would reduce the normal capacity of the water system to 3.16 mgd minus the capacity of failed facility or pump. • Reduction in average daily water consumption by 5% or 158,000 gallons per day • Consumption (85%) has existed for a period of three days • Weather conditions are to be considered in drought classification determination. Predicted long, hot, or dry periods are to be considered in impact analysis.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: Triggering Conditions (City of Mabank) • Average daily water consumption reaches 90% of rated production capacity for a three day period. Production capacity is defined as on line capacity in case of failure of a pump. This failure would reduce the normal capacity of the water system to 3.16 mgd minus the capacity of the failed pump or facility. • Reduction in average daily water consumption of 10% or 316,000 gallons per day. • Weather conditions indicate mild drought will exist five (5) days or more. • One ground storage tank or one clear well is taken out of service during mild drought period and reduces the storage capacity of the water system below 75% of normal water storage capacity. • Storage capacity (water level) is not being maintained during period of 100% rated production period. Storage capacity is 75% or less of	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: Triggering Conditions (City of Mabank) • Average daily water consumption reaches 90% of rated production capacity for a three day period. Production capacity is defined as on line capacity in case of failure of a pump. This failure would reduce the normal capacity of the water system to 625,000 mgd minus the capacity of the failed pump or facility. • Weather conditions indicate severe drought will exist five (5) days or more. • One ground storage tank or one clear well is taken out of service during mild drought period and reduces the storage capacity of the water system below 75% or 628,500 gallons of normal water storage capacity. • Storage capacity (water level) is not being maintained during period of 100% rated production period. Storage capacity is 75% (628,500 Gallons) or less of normal capacity.	25%				

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
MABANK, continued								normal capacity. • Existence of any one listed condition for a duration of 36 hours.		• Existence of any two listed conditions for Stage 2, for a duration of 24 hours.					
NORTHLAKE	5/10/2012	WUG	Fort Worth (TRWD)	TRWD Sources Woodbine Aquifer	4	• TRWD/Fort Worth has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: (A) Annually beginning on May 1 through September 30; (B) The water available to the town is equal to or less than 50% of storage; (C) Demand exceeds 90% of deliverable capacity for 3 consecutive days; (D) Water demand approaches a reduced delivery capacity for all or part of the system due to supply or production capacity limitations including contamination of the system; or (E) Pursuant to the requirements of any wholesale water purchase contract, notification is received requesting initiation of stage 1 of the plan.		• TRWD/Fort Worth has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: (A) The water available to the town is equal to or less than 60% of storage; (B) Total daily water demand equals or exceeds 100% of the prior year's maximum daily demand for 3 consecutive days or 110% on a single day; (C) Demand exceeds 95% of deliverable capacity for 2 consecutive days; (D) Water demand equals a reduced delivery capacity for all or part of the system due to supply or production capacity limitations including contamination of the system.		• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: (A) The water available to the town is equal to or less than 65% of usable storage; (B) Total daily water demand equals or exceeds 105% of the prior year's maximum daily demand for 3 consecutive days or 115% on a single day; (C) Demand exceeds 95% of deliverable capacity for 5 consecutive days; (D) Water demand exceeds a reduced delivery capacity for all or part of the system due to supply or production capacity limitations including contamination of the system.		(A) The water available to the town is equal to or less than 70% of storage; (B) Total daily water demand equals or exceeds 110% of the prior year's maximum daily demand for 3 consecutive days or 120% of the prior year's maximum daily demand on a single day; (C) Demand exceeds 100% of deliverable capacity for 2 consecutive days; (D) Water demand seriously exceeds a reduced delivery capacity for all or part of the system due to supply or production capacity limitations including contamination of the system.			
RICHLAND HILLS	5/10/2011	WUG	Fort Worth (TRWD)	TRWD Sources Trinity Aquifer	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Mild conditions: Daily water demand reaches 80 percent of the production capacity of the system for three consecutive days.		• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: Moderate conditions: Daily water demand reaches 90 percent of the production capacity of the system for three consecutive days.		• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: Severe conditions: Daily water demand reaches 100 percent of the production capacity of the system for three consecutive days; or the imminent or actual failure of a major component of the system is experienced which can cause an immediate health or safety hazard; or a significant reduction in the production capacity of the system is experienced.					
RIVER OAKS	9/27/2011	WUG	TRWD	TRWD Sources	3	• TRWD has initiated Stage 1	5%	• TRWD has initiated Stage 2	10%	• TRWD has initiated Stage 3	20%				
ROCKETT SUD	4/16/2013	WUG	TRA (TRWD) Midlothian (TRA)	TRWD Sources Joe Pool Lake	4	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause Rockett SUD to implement Stage 1 restrictions: When total daily water demands equals or exceeds 80% of the safe operating capacity of 10million gallons per day for 3 consecutive days.	20%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause Rockett SUD to implement Stage 2 restrictions: When the total daily water demands equals or exceeds 90% of the safe operating capacity of 11 million gallons per day for 3 consecutive days.	20%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause Rockett SUD to implement Stage 3 restrictions: When the total daily water demands equals or exceeds 100% of the safe operating capacity of 12 million gallons per day for 3 consecutive days.	20%	When a major water line breaks, pump or system failures occur which causes unprecedented loss or capacity to provide water service or natural or man -made contamination of District a water supply sources occurs.			

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
SAGINAW	4/15/2014	WUG	Fort Worth (TRWD)	TRWD Sources	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Water demand reaches or exceeds 90% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. Saginaw' s water distribution system becomes contaminated. Saginaw' s water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. Saginaw' s water supply system is unable to deliver water due to the failure or damage of major water system components.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: Water demand reaches or exceeds 95% of reliable delivery capacity for three consecutive days. The delivery capacity could be citywide or in a specified portion of the system. Contamination of the water supply source(s) or water supply system. Demand for all or part of the delivery system equals or exceeds delivery capacity because delivery capacity is inadequate. Water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: Water demand has reaches or exceeds 98% of reliable delivery capacity for one day. The delivery capacity could be citywide or in a specified portion of the system. Contamination of the water supply source(s) or water supply system. Demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. Water supply system is unable to deliver water due to the failure or damage of major water system components.	20%				
SOUTHLAKE	4/21/2009	WUG	Fort Worth (TRWD)	TRWD Sources	3	• TRWD/Fort Worth has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: This stage is activated by the Director of Public Works if there is a water system failure including pumping equipment, supply lines, distribution lines, power failure, or storage facilities, or: • The tank level in the three elevated tanks of the low pressure plane fall below 18 feet, measured from the bottom of the tank bowl to the water level in the tank, and continue to fall below this level, with the Pearson Road Pump Station at 100% capacity, for three consecutive days. • The tank level in the single elevated tank in the high pressure plane falls below 18 feet, measured from the bottom of the tank bowl to the water level in the tank, and continue to fall below this level, with the Pearson Road Pump Station at 100% capacity, for three consecutive days.	5%	• TRWD/Fort Worth has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: This stage is activated by the Director of Public Works if there is a water system failure including pumping equipment, supply lines, distribution lines, power failure, or storage facilities, or if Stage 1 water watch has been initiated and in effect for two weeks, and: • The tank level in the three elevated tanks of the low pressure plane fall below 18 feet, measured from the bottom of the tank bowl to the water level in the tank, and continue to fall below this level, with the Pearson Road Pump Station at 100% capacity, for three consecutive days. • The tank level in the single elevated tank in the high pressure plane falls below 18 feet, measured from the bottom of the tank bowl to the water level in the tank, and continue to fall below this level, with the Pearson Road Pump Station at 100% capacity, for three consecutive days.	10%	• TRWD/Fort Worth has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: This stage is activated by the Director of Public Works if there is a water system failure including pumping equipment, supply lines, distribution lines, power failure, or storage facilities, or if Stage 2 water watch has been initiated and in effect for two weeks, and: • The tank level in the three elevated tanks of the low pressure plane fall below 12 feet, measured from the bottom of the tank bowl to the water level in the tank, and continue to fall below this level, with the Pearson Road Pump Station at 100% capacity, for three consecutive days. • The tank level in the single elevated tank in the high pressure plane falls below 12 feet, measured from the bottom of the tank bowl to the water level in the tank, and continue to fall below this level, with the Pearson Road Pump Station at 100% capacity, for three consecutive days.	20%				

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
TROPHY CLUB	4/22/2014	WUG	Trophy Club MUD #1 (Fort Worth (TRWD))	TRWD Sources Trinity Aquifer	3	• TRWD/Fort Worth has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: 1. Water demand reaches or exceeds 90% of reliable delivery capacity for three (3) consecutive days. 2. Contamination of the City of Fort Worth's water treatment or distribution system. 3. Inadequate delivery capacity by the City of Fort Worth. 4. Failure of or damage to the City of Fort Worth's water supply system. 5. Water demand approaches a reduced delivery capacity for all or part of the system due to supply or production capacity limitation including contamination of the system. 6. Conditions within the District's water system that warrant a mild reduction in water usage. These conditions may include loss of supply, storage, or pumping capacity, water main break, or other system failure.	5%	• TRWD/Fort Worth has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: 1. Water demand reaches or exceeds 95% of reliable delivery capacity for three (3) consecutive days. The delivery capacity could be District-wide or in a specified portion of the system. 2. Contamination of the water supply source(s) or water supply system. 3. Demand for all or part of the delivery system equals or exceeds delivery capacity because delivery capacity is inadequate.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: 1. Water demand has reached or exceeds 98% of reliable delivery capacity for one (1) day. 2. Contamination of the water supply source(s) or water supply system. 3. Demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. 4. Conditions within the District's water system that warrant a major reduction in water usage. These conditions may include loss of supply, storage, or pumping capacity, water main break, or other system failure.	20%				
WALNUT CREEK SUD	9/16/2014	WUG	TRWD	Lake Bridgeport	3	• TRWD has initiated Stage 1	5%	• TRWD has initiated Stage 2	10%	• TRWD has initiated Stage 3	30%				
WAXAHACHIE	4/21/2014	WUG	TRA (TRWD)	Lake Waxahachie Lake Bardwell TRWD Sources	5	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: When Lake Waxahachie elevation drops to 527' msl. This is 4.5-feet below spillway elevation and the lake is operating at less than 74 percent capacity	2%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: When Lake Waxahachie elevation drops to 524' msl. This is 7.5-feet below spillway elevation and the lake is operating at less than 68 percent capacity	5%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: When Lake Waxahachie elevation drops to 520' msl. This is 11.5-feet below spillway elevation and the lake is operating at less than 45 percent capacity	10%	When Lake Waxahachie elevation drops to 517.5' msl. This is 14-feet below spillway elevation and the lake is operating at less than 25 percent capacity	15%	When the City Manager, or his/her designee, determines that a water supply emergency exists based on: 1. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or 2. Natural or man-made contamination of the water supply source(s).	30%

TRWD and TRWD Customers DCP															
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
WEATHERFORD	3/12/2013	WUG	TRWD	Lake Weatherford TRWD Sources	3	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: (a) The lake level in Lake Weatherford reaches 889.0 feet or 61.5% capacity; or (b) Water demand reaches 85 percent of the water treatment capacity or (c) Any mechanical failure of pumping equipment will require more than 48 hours to repair when dry weather conditions exist and continued dry weather is expected.	5%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: (a) The lake level in Lake Weatherford reaches 887.5 feet or 54% capacity; or (b) Water demand reaches 85 percent of the water treatment capacity or (c) Any mechanical failure of pumping equipment will require more than 48 hours to repair when dry weather conditions exist and continued dry weather is expected.	10%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: (a) The lake level in Lake Weatherford reaches 885.5 feet or 45% percent capacity; or (b) Water demand reaches 85 percent of the water treatment capacity or (c) Major water line breaks, pump or system failures occur, which cause unprecedented loss of capability to provide water service; or (d) Natural or man-made contamination of the water supply source(s)	20%				
TRINITY RIVER AUTHORITY (TCWSP)	4/1/2014	WWP	TRWD	TRWD Sources	3	• TRWD has initiated Stage 1	5%	• TRWD has initiated Stage 2	10%	• TRWD has initiated Stage 3	20%				
WISE COUNTY WSD	3/1/2011	WWP	TRWD	Lake Bridgeport	4	Annually, beginning on May 1 through September 30.	10%	• TRWD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: a. When, pursuant to requirements specified in the WCWSD wholesale water purchase contract with Tarrant Regional Water District, notification is received requesting initiation of Stage 1 Water Watch of the Drought Contingency Plan. b. When the total daily water demand equals or exceeds 1.8 million gallons 3 consecutive days or 2.2 million gallons on a single day. c. Continually falling treated water reservoir levels which do not refill above 95% percent overnight (e.g., bases on an evaluation of minimum treated water storage required to avoid system outage).	15%	• TRWD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: 1. When, pursuant to requirements specified in the WCWSD wholesale water purchase contract with Tarrant Regional Water District, notification is received requesting initiation of Stage 2 Water Warning of the Drought Contingency Plan. 2. When the total daily water demand equals or exceeds 2.2 million gallons for 3 consecutive days or 2.4 million gallons on a single day. 3. Continually falling treated water reservoir levels which do not refill above 85% percent overnight (e.g., based on an evaluation of minimum treated water storage required to avoid system outage).	25%	• TRWD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: 1. When, pursuant to requirements specified in the WCWSD wholesale water purchase contract with Tarrant Regional Water District, notification is received requesting initiation of Stage 3 Emergency Water Use of the Drought Contingency Plan. 2. When total daily water demands equals or exceeds 2.4 million gallons for 7 consecutive days. 3. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service. 4. Natural or man-made contamination of the water supply source(s). 5. Continually falling treated water reservoir levels which do not refill above 75% percent overnight (e.g., based on an evaluation of minimum treated water storage required to avoid system outage).	50%		

UTRWD and UTRWD Customers DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
UPPER TRINITY REGIONAL WATER DISTRICT (UTRWD)	9/1/2012	WWP		Lake Ray Roberts, Lake Lewisville, Jim Chapman Lake	4	The following are key conditions, any one of which may trigger this stage: • The total raw water supply in the water supply lakes available to Upper Trinity has dropped below 65% (35% depleted); or • Dallas Water Utilities has initiated Stage 1 and given notice to Upper Trinity; or • Water demand has reached or exceeded 80% of treatment capacity for four consecutive days; or • Water demand is approaching a level that will cause a reduced delivery capacity for all or part of the transmission system, as determined by Upper Trinity; or • The Executive Director, with the concurrence of the Upper Trinity Board of Directors, finds that conditions warrant the declaration of Stage 1.	1%	The following are key conditions, any one of which may trigger this stage: • The total raw water supply in the water supply lakes available to Upper Trinity has dropped below 55% (45% depleted); or • Dallas Water Utilities has initiated Stage 2 and given notice to Upper Trinity; or • Water demand has reached or exceeded 85% of treatment capacity for three consecutive days; or • Water demand has reached a level that is causing a reduced delivery capacity for all or part of the transmission system, as determined by Upper Trinity; or • System is unable to deliver water at normal rates due to failure of, or damage to, major water system components; or • A significant deterioration in the quality of a water supply, being affected by a natural or man-made source; or • The Executive Director, with the concurrence of the Upper Trinity Board of Directors, finds that conditions warrant the declaration of Stage 2.	5%	The following are key conditions, any one of which may trigger this stage: • The total raw water supply in the water supply lakes available to Upper Trinity has dropped below 45% (55% depleted); or • Dallas Water Utilities has initiated Stage 3 and given notice to Upper Trinity; or • Water demand has reached or exceeded 90% of treatment capacity for two consecutive days; or • Water demand exceeds the delivery capacity for all or part of the transmission system, as determined by Upper Trinity; or • System is unable to deliver water at normal rates due to failure of, or damage to, major water system components; or • Interruption of one or more water supply sources; or • Natural or man-made contamination of an Upper Trinity water supply source(s) that threatens water availability; or • The Executive Director, with the concurrence of the Upper Trinity Board of Directors, finds that conditions warrant the declaration of Stage 2.	15%	The following are key conditions, any one of which may trigger this stage: • The total raw water supply in the water supply lakes available to Upper Trinity has dropped below 30% (70% depleted); or • Dallas Water Utilities has initiated Stage 4 and given notice to Upper Trinity; or • Water demand has reached or exceeded 100% of treatment capacity for two consecutive days; or • Water demand has exceeded the delivery capacity for all or part of the transmission system, as determined by Upper Trinity; or • System is unable to deliver water at normal rates due to failure of, or damage to, major water system components; or • Interruption of one or more water supply sources; or • Natural or man-made contamination of an Upper Trinity water supply source(s) that threatens water availability; or • The Executive Director, with the concurrence of the Upper Trinity Board of Directors, finds that conditions warrant the declaration of Stage 2.	25%				
AUBREY	4/21/2009	WUG	UTRWD	Trinity Aquifer UTRWD Sources	5	When any one of the following occurs: (i) UTRWD has announced Stage 1 ; or (ii) When the combined specific capacity of the city's well(s) is equal to or less than 90 percent (695,952 gallons per day) of the well's original specific capacity.	10%	These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: (i) UTRWD has announced Stage 2 ; (ii) When the combined specific capacity of the city's well(s) is equal to or less than 85 percent (657,288 gallons per day) of the well 's original specific capacity; or (iii) When the total daily water demand equals or exceeds 541,296 gallons (70% production capability) for 3 consecutive days or 579,960 gallons (75%	20%	These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: (i) UTRWD has announced Stage 3 (ii) When the combined specific capacity of the city' s well(s) is equal to or less than 80 percent (618,624 gallons per day) of the well's original specific capacity; or (iii) When the total daily water demand equals or exceeds 579,960 gallons (75% production capability) for 3 consecutive days or 618,624 gallons (80%	30%	• UTRWD has announced Stage 4 These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: (i) Pursuant to requirements specified in the city' s wholesale water purchase contract with the Upper Trinity Regional Water District, notification is received requesting initiation of Stage 4 of the drought contingency plan; (ii) When the combined specific capacity of the city's well(s) is equal to or less than 75 percent (579,960	40%	When the mayor, or his/her designee, determines that a water supply emergency exists based on: (i) Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or (ii) Natural or man-made contamination of the water supply source(s).	50%		

UTRWD and UTRWD Customers DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
AUBREY, continued								production capability) on a single day.		production capability) on a single day.		gallons per day) of the well's original specific capacity; or (iii) When the total daily water demand equals or exceeds 618,624 gallons (80% production capability) for 3 consecutive days or 695,952 gallons (90% production capability) on a single day.					
CELINA	1/1/2004	WUG	UTRWD	UTRWD Trinity Aquifer Woodbine Aquifer	6	These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: (A) An inability to recover in ground storage or elevated storage facilities within a 24-hour period exists; (B) UTRWD has announced Stage 1 (C) Usage exceeds pumping capabilities.	10%	These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: (A) An inability to recover approximately 90% in ground storage and elevated storage tanks within a 24-hour period exists; (B) UTRWD has announced Stage 2 (C) Usage exceeds pumping capabilities.	20%	These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: (A) An inability to recover approximately 75% in ground and elevated storage tanks within a 24-hour period exists; or (B) UTRWD has announced Stage 3	40%	• UTRWD has announced Stage 4 These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: (A) An inability to recover approximately 50% in ground and elevated storage tanks within a 24-hour period exists; or (B) The wholesale water supplier asks for Stage 4 implementation.	60%	(A) Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service, or extended power outage; (B) Natural or man-made contamination of the water supply source(s); or (C) When the wholesale water supplier can no longer supply treated water.	80%	When the wholesale water supplier puts restrictions or rations the amount of water it can supply the city	
FLOWER MOUND	4/5/2010	WUG	UTRWD DWU	UTRWD Sources DWU Sources	4	• UTRWD has announced Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: a. Either wholesale water supplier(s) implement restrictive measures that require customers to implement similar restrictions for reasons such as conserving reservoir levels, maintaining system pressures, water treatment capacity, or other such items requiring cooperation; or b. Total water consumption reaches seventy-five percent (75%) of the Town's water distribution pumping capacity; or, c. The water supply system has a significant limitation due to failure of or damage to important system components.	1%	• UTRWD has announced Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: a. Either average daily water demand reaches ninety percent (90%) of available supply for two (2) consecutive days; or b. Average daily water demand reaches ninety percent (90%) of the Town's water distribution system pumping capacity for two (2) consecutive days; or c. Failures occur with Town or wholesale supplier equipment or systems that result in a situation where demand reaches ninety percent (90%) of remaining supply or system capacity; or d. Wholesale suppliers implement restrictive measures that require customers to implement similar restrictions for reasons such as conserving reservoir levels, maintaining system pressures, water treatment capacity or other items requiring cooperation.	5%	• UTRWD has announced Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: a. Either average daily water demand reaches ninety-five percent (95%) of available supply for two (2) consecutive days; or b. Average daily water demand reaches ninety-five percent (95%) of the Town's water distribution system pumping capacity for two (2) consecutive days; or c. Failures occur with Town or wholesale supplier equipment or systems that result in a situation where demand reaches ninety-five percent (95%) of remaining supply or system capacity, or d. Wholesale suppliers implement restrictive measures that require customers to implement similar restrictions for reasons such as conserving reservoir levels, maintaining system pressures, water	15%	• UTRWD has announced Stage 4 These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: a. Either average daily water demand reaches ninety-eight percent (98%) of the Town's water distribution system pumping capacity for one (1) day; or b. The water system is contaminated either accidentally or intentionally; or c. Major waterline breaks, or pump or system failure occurs causing unprecedented loss of capacity to provide treated water service; or d. Wholesale suppliers implement restrictive measures that require customers to implement similar restrictions for reasons such as conserving reservoir levels, maintaining system pressures, water treatment capacity, or other items requiring cooperation.	25%				

UTRWD and UTRWD Customers DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
FLOWER MOUND, continued										treatment capacity or other items requiring cooperation.							
HIGHLAND VILLAGE	4/14/2014	WUG	UTRWD	UTRWD Sources Trinity Aquifer	4	• UTRWD has announced Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: Effective each year beginning May 15th and ending September 30th or dates as amended under this ordinances' implementation authority. The City Manager is authorized to implement Phase I -Seasonal Conservation measures earlier than May 1st or extend them to later than September 30 upon receipt of a notice from the Upper Trinity Regional Water District (UTRWD) that it has implemented its water conservation plan and emergency demand management and requests that the City implement the City's water conservation measures; provided, however, such extended dates shall only run concurrently with the dates during which UTRWD has implemented its own measures.	2%	These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: a) When in the opinion of the City Manager or Designee the supply of water is inadequate to meet the previous Phase. b) When total system supply is reduced by a minimum 8% for greater than 8 days. Example: storage at beginning of the day is 7,250,000 gals. Storage at the end of the day is 6,670,000 gals. c) When demand exceeds 80% of supply for three (3) consecutive days or 100% for two (2) consecutive days. d) UTRWD has announced Stage 2 e) When the State of Texas declares this region to be in a severe drought or greater.	3%	These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: a) When in the opinion of the City Manager or Designee the supply of water is inadequate to meet the previous Phase. b) When total system supply is reduced by a minimum 10% for greater than 10 days. Example: storage at beginning of day is 7,250,000 gals. Storage at the end of the day is 6,525,000 gals. c) When demand exceeds 100% of supply for four (4) consecutive days or 120% for three (3) consecutive days. (d) UTRWD has announced Stage 3 (e) When the State of Texas declares this region to be in a severe drought or greater.	20%	These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: a) Resolution by the City Council. b) When total system supply is reduced by a minimum of25% for greater than 10 days. Storage at the beginning of the day is 7,250,000 gals. Storage at the end of the day is 5,437,500 gals. c) When demand exceeds 125% of supply for four (4) consecutive days or 150% for two (2) consecutive days or 100% for fourteen (14) days. d) Water system is contaminated either accidentally or intentionally. e) System fails from a catastrophic event such as storms or causes of man. f) UTRWD has announced Stage 4 g) When the State of Texas declares this region to be in an extreme drought.	50%				
SANGER	4/1/2014	WUG	UTRWD	UTRWD Sources Trinity Aquifer	4	• UTRWD has announced Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • Water demand has reached or exceeded [80%] of delivery capacity for four consecutive days; or • Water demand is approaching a level that will cause a reduce delivery capacity for all or part of the distribution system, as determined by Sanger or • The water supply system has a significant limitation due to failure of or damage to important water system components.	1%	• UTRWD has announced Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • Water demand has reached or exceeded [85%] of delivery capacity for four consecutive days; or • Water demand has reached a level that is causing a reduced delivery capacity for all or part of the distribution system, as determined by Sanger or • The water supply system in unable to deliver water at normal rates due to failure of or damage to major water system components or • A significant deterioration	5%	• UTRWD has announced Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • Water demand has reached or exceeded [90%] of delivery capacity for four consecutive days; or • Water demands exceeds the delivery capacity for all or part of the distribution system, as determined by Sanger; or • Water supply system in unable to deliver water in adequate quantities due to failure of or damage to major water system components; or • Interruption of one or	15%	• UTRWD has announced Stage 4 These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: • Water demand has reached or exceeded [98%] of delivery capacity for four consecutive days; or • Water supply system in unable to deliver adequate quantities of water due to failure of or damage to major water system components; or • Interruption of one or more water supply source(s). • Natural or man-made contamination of the water supply available to Sanger.	25%				

UTRWD and UTRWD Customers DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
SANGER, continued								in the quality of a water supply, being affected by a natural or man-made source.		more water supply source(s). • Natural or man-made contamination of the water supply source that threatens water availability.							
LAKE CITIES MUA	11/17/2014	WWP	UTRWD	UTRWD Sources	4	• UTRWD has announced Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • Water demand has reached or exceeded [80%] of delivery capacity for four consecutive days; or • Water demand is approaching a level that will cause a reduce delivery capacity for all or part of the distribution system, as determined by LCMUA or • The water supply system has a significant limitation due to failure of or damage to important water system components.	1%	• UTRWD has announced Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • Water demand has reached or exceeded [85%] of delivery capacity for four consecutive days; or • Water demand has reached a level that is causing a reduced delivery capacity for all or part of the distribution system, as determined by LCMUA or • The water supply system in unable to deliver water at normal rates due to failure of or damage to major water system components or • A significant deterioration in the quality of a water supply, being affected by a natural or man-made source.	5%	• UTRWD has announced Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • Water demand has reached or exceeded [90%] of delivery capacity for four consecutive days; or • Water demands exceeds the delivery capacity for all or part of the distribution system, as determined by LCMUA; or • Water supply system in unable to deliver water in adequate quantities due to failure of or damage to major water system components; or • Interruption of one or more water supply source(s). • Natural or man-made contamination of the water supply source that threatens water availability.	15%	• UTRWD has announced Stage 4 These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: • Water demand has reached or exceeded [98%] of delivery capacity for four consecutive days; or • Water supply system in unable to deliver adequate quantities of water due to failure of or damage to major water system components; or • Interruption of one or more water supply source(s). • Natural or man-made contamination of the water supply available to LCMUA.	25%				

Additional DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
BRAZOS RIVER AUTHORITY	10/29/2012	WWP		Possum Kingdom Lake Lake Granbury Lake Limestone Allens Creek Federal Reservoirs	4												
DALLAS COUNTY PARK CITIES MUD	4/8/2014	WWP		Lake Grapevine	4	• The District's water supply in Grapevine Lake becomes 35% depleted. • Grapevine Reservoir becomes contaminated. • The District's demand exceeds 90% of its delivery capacity for seven consecutive days. • The District's water supply system is unable to deliver water to its customers due to the failure or damage of major water system components. • Any other condition that would cause the District to initiate Stage I.	2%	• The District's water supply in Grapevine Lake becomes 45% depleted. • Grapevine Reservoir becomes contaminated. • The District's demand exceeds 95% of its delivery capacity for five consecutive days. • The District's water system is unable to deliver water to its customers due to the failure or damage of major water system components. • Any other condition that would cause the District to initiate Stage II.	5%	• The District's water supply in Grapevine Lake becomes 55% depleted. • Grapevine reservoir has been contaminated. • The District's demand exceeds 98% of its delivery capacity for three consecutive days. • The District's water supply system is unable to deliver water to its customers due to the failure or damage of major water system components. • The District's water use is approaching the limit of the permitted supply. • Any other condition that would cause The District to initiate Stage III.	10%	• The District's water supply in Grapevine Lake becomes 70% depleted. • Grapevine reservoir has been contaminated. • The District's demand exceeds its delivery capacity. • The District's water supply system is unable to deliver water to its customers due to the failure or damage of major water system components. • The District's water use is approaching the limit of the permitted supply. • Any other condition that would cause the District to initiate Stage IV.	25%				
GREATER TEXOMA UTILITY AUTHORITY	8/1/2014	WWP			3	• The GTUA President or designee, with concurrence of the GTUA Board of Directors, finds that conditions warrant the declaration of Stage 1. • Water demand is projected to approach the limit of the permitted supply. • Water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days. • Water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • The NTMWD has initiated Stage 1 (applies to treated water customers only)	5%	• The GTUA President or designee, with concurrence of the GTUA Board of Directors, finds that conditions warrant the declaration of Stage 2. • Water demand is projected to approach or exceed the limit of the permitted supply. (Applies to Raw Water Customers only) • Raw Water Customers have used more than 50% of GTUA's authorized storage. (Applies to Raw Water Customers only) • Water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days. • Water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Water supply system is unable to deliver water	10%	• The GTUA President or designee, with concurrence of the GTUA Board of Directors, finds that conditions warrant the declaration of Stage 3. • Water demand is projected to approach or exceed the limit of the permitted supply. • Source has become severely limited in availability. • Water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days. • Water demand for all or part of the delivery system seriously exceeds delivery capacity because delivery capacity is inadequate. • Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • The NTMWD has	As necessary						

Additional DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
GREATER TEXOMA UTILITY AUTHORITY, continued								due to the failure or damage of major water system components. • The NTMWD has initiated Stage 2 (applies to treated water customers only)		initiated Stage 3 (applies to treated water customers only)							
RED RIVER AUTHORITY	4/1/2014	WWP		RRA Sources	4	System water production capacity drops 20% and remains consistent for a period of at least 60 consecutive days.	20%	System water production capacity drops 30% and remains consistent for a period of at least 30 consecutive days.	30%	System water production capacity drops 40% and remains consistent for a period of at least 20 consecutive days.	40%	System water production capacity drops 50% and remains consistent for a period of at least 10 consecutive days.	As necessary				
TRINITY RIVER AUTHORITY (OTHER)	4/1/2014	WWP		Bardwell Lake Navarro Mills Lake Joe Pool Lake	4	The Authority will recognize that a mild water shortage condition exists when the water surface elevation of each corresponding reservoir reaches the following triggering criteria: 1. Water surface elevation of Bardwell Reservoir declines below 417.0 feet 2. Water surface elevation of Joe Pool Reservoir declines below 516.0 feet 3. Water surface elevation of Navarro Mills Reservoir declines below 421 .5 feet	5%	The Authority will recognize that a moderate water shortage condition exists when the water surface elevation of each corresponding reservoir reaches the following triggering criteria: 1. Water surface elevation of Bardwell Reservoir declines below 414.0 feet 2. Water surface elevation of Joe Pool Reservoir declines below 511.0 feet 3. Water surface elevation of Navarro Mills Reservoir declines below 419.0 feet	10%	The Authority will recognize that a severe water shortage condition exists when the water surface elevation of each corresponding reservoir reaches the following triggering criteria: 1. Water surface elevation of Bardwell Reservoir declines below 408.0 feet 2. Water surface elevation of Joe Pool Reservoir declines below 501.0 feet 3. Water surface elevation of Navarro Mills Reservoir declines below 414.5 feet	30%	The Authority will recognize that an emergency water shortage condition exists when any of the following occur in a particular reservoir: • Natural or man-made contamination of the water supply source occurs; and • Any condition exists which prevents or imminently threatens to prevent Authority customers from withdrawing sufficient water from each individual reservoir to meet demands.					
ANNETTA	6/13/2013	WUG		Trinity Aquifer	4	Annually, beginning on May 1 through September 30.	7%	Falling treated water reservoir levels which do not refill above 90 percent overnight for seven consecutive days.	15%	Falling treated water reservoir levels which do not refill above 75 percent overnight for seven consecutive days.	25%	• Supply source becomes contaminated. • Water supply system is unable to deliver water due to the failure or damage of major water system components. • Stage 3 conditions persist or worsen such that the system is unable to maintain sufficient ground storage tank levels with adequate recovery time, pressures in the system fall below 40 psi, and/or aquifer levels drop that affect pump efficiencies and/or production capabilities.	As necessary				
ATHENS	9/13/2011	WUG	AMWA	Carrizo-Wilcox Aquifer Lake Athens	6	When any of the following events occur: • Total daily production of potable water exceeds 4.5 million gallons per day (MGD); or, • The water surface elevation of Lake Athens drops to 436.90 feet MSL	10%	When any of the following events occur: • Total daily production of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 80% capacity overnight; or, • The water surface	Reduce daily water usage to 4.0 MGD or less	When any of the following events occur: • Total daily production of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 65% capacity overnight; or, • The water surface	Reduce daily water usage to 4.0 MGD or less	When any of the following events occur: • Total daily production of potable water exceeds 4.5 MGD and the storage facilities do not refill to a level above 50% capacity overnight; or, • The water surface	Reduce daily water usage to 4.0 MGD or less	When the Board President or his/her designee determines that a water supply emergency exists, based upon any of the following triggering criteria: • Major water line breaks or pump or system	Usage ≤ 4.0 MGD	When any of the following events occur: • Total daily production of potable water exceeds 5.5 MGD and the storage facilities do not refill to a level above 35% capacity overnight; or, • The water surface	

Additional DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
ATHENS, continued						(75% of net usable volume).		elevation of Lake Athens drops to 434.60 feet MSL (60% of net usable volume).		elevation of Lake Athens drops to 432.00 feet MSL (45% of net usable volume).		elevation of Lake Athens drops to 429.00 feet MSL (30% of net usable volume).		failures occur, which cause an unprecedented loss of capability to provide water service; or • Natural or man-made contamination of the water supply source(s) occurs; or • Water supply sources are depleted to a level beyond those described above for Stage 4- Critical Water Shortage Conditions.		elevation of Lake Athens drops to 425.50 feet MSL (15% of net usable volume).	
BLUE MOUND	4/14/2014	WUG		Trinity Aquifer	5	Between May 1st and September 30th	10%	- 60 percent of water treatment capacity reached for 3 or more days in a week or - 15 well pump hours per day for more than 3 days.	10%	- 75 percent of water treatment capacity reached for 3 or more days in a week or - 18 well pump hours per day for more than 3 days.	20%	- 90 percent of water treatment capacity reached for 3 or more days in a week or - 22 well pump hours per day for more than 3 days.	30%	Upon notification by the managing Groundwater Conservation District or Regional Surface Water Authority that the District or Authority has declared Exceptional Drought Stage or if critical system capacities are threatened or system failures are imminent the Utility will activate Stage IV.	40%		
CRESSON	6/10/2014	WUG		Trinity Aquifer	6	When total daily water demand equals or exceeds 4.8 million gallons for 30 consecutive days and/or 150,000 gallons on a single day.	10%	When daily usage exceeds 160,000 gallons per day	20%	When daily usage exceeds 180,000 gallons per day	30%	When daily usage exceeds 200,000 gallons per day	40%	When the Mayor, or his/her designee, determines that a water supply emergency exists based on: 1. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or 2. Natural or man-made contamination of the water supply source(s).	50%	When the system experiences continually falling treated water reservoir levels which do not refill above 50% overnight.	
ENNIS	4/1/2014	WUG		Lake Bardwell	5	When the elevation of Lake Bardwell is equal to or less than 417' MSL or 74% of available capacity, and/or the daily potable water supply system demand is 6.0 Million Gallons per Day (MOD) or 50% of plant capacity		When the elevation of Lake Bardwell is equal to or less than 414' MSL or 54% of available capacity, and/or the daily potable water supply system demand is 7.2 Million Gallons per Day (MOD) or 60% of plant capacity		When the elevation of Lake Bardwell is equal to or less than 4I2' MSL or 40% of available capacity, and/or the daily potable water supply system demand is 9.0 Million Gallons per Day (MGD) or 75% of plant capacity		When the elevation of Lake Bardwell is equal to or less than 409' MSL or 20% of available capacity, and/or the daily potable water supply system demand is 10.8 Million Gallons per Day (MGD) or 90% of plant capacity		When the City Manager, or his designee, determines that a water supply emergency exists based on: I. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; 2. Natural or man-made contamination of the water supply source(s); or 3. Any other situation			

Additional DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
ENNIS, continued														deemed an emergency by the City Manager.			
GAINESVILLE	5/1/2014	WUG		Moss Lake Trinity Aquifer	5	• The Mayor or his/her designee finds that conditions warrant the declaration of Stage 1 • The water storage level in Moss Lake is less than 65% of the total conservation pool capacity • Ground water level reaches 100' above current pump settings • City's water demand exceeds 90 percent of the amount that can be delivered to customers for three consecutive days. • City's water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate. • Water demand is approaching the limit of the permitted supply	2%	• The Mayor or his/her designee finds that conditions warrant the declaration of Stage 1 • The water storage level in Moss Lake is less than 55% of the total conservation pool capacity • Ground water level reaches 75' above current pump settings • City's water demand exceeds 95 percent of the amount that can be delivered to customers for three consecutive days • City's water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate • Water demand is approaching the limit of the permitted supply.	5%	• The Mayor or his/her designee finds that conditions warrant the declaration of Stage 3 • The water storage level in Moss Lake is less than 45% of the total conservation pool capacity • Ground water level reaches 50' above current pump settings • City's water demand exceeds 98 percent of the amount that can be delivered to customers for three consecutive days • City's water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate • Water demand is approaching the limit of the permitted supply.	10%	• The Mayor or his/her designee finds that conditions warrant the declaration of Stage 4 • The water storage level in Moss Lake is less than 35% of the total conservation pool capacity • Ground water level reaches 40' above current pump settings • City's water demand exceeds the amount that can be delivered to customers • City's water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate • Water demand is approaching the limit of the permitted supply.	As necessary	• The Mayor or his/her designee finds that conditions warrant the declaration of Stage 5 • Major water line breaks, or pump or system failure occur, which cause unprecedented loss of capability to provide water service or • National or manmade contamination of the water supply sources occurs	As necessary		
HIGHLAND PARK	4/28/2014	WUG	DCPCMUD	Grapevine Lake	4	•DCPCMUD has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: • The Town's water use is approaching the limit of its contracted supply. • The Town's demand exceeds 90% of its delivery capacity for seven consecutive days. • The Town's water demand for any portion of the delivery system approaches the delivery capacity. • The Town's supply source or delivery system becomes contaminated. • The Town's water supply system is unable to deliver water due to the failure or damage of major water system components.	2%	•DCPCMUD has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: • The Town's water use is approaching the limit of its contracted supply. • The Town's demand exceeds 95% of its delivery capacity for seven consecutive days. • The Town's water demand for any portion of the delivery system approaches the delivery capacity. • The Town's supply source or delivery system becomes contaminated. • The Town's water supply system is unable to deliver water due to the failure or damage of major water system components.	5%	•DCPCMUD has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: • The Town's water use is approaching the limit of its contracted supply. • The Town's demand exceeds 98% of its delivery capacity for seven consecutive days. • The Town's water demand for any portion of the delivery system approaches the delivery capacity. • The Town's supply source or delivery system becomes contaminated. • The Town's water supply system is unable to deliver water due to the failure or damage of major water system components.	10%	•DCPCMUD has initiated Stage 4 These triggers below are internal triggers which may cause the City to implement Stage 4 restrictions: • The Town's demand exceeds the amount that can be delivered to customers. • The Town's water demand for any portion of the delivery system seriously exceeds delivery capacity. • The Town's supply source or delivery system becomes contaminated. • The Town's water supply system is unable to deliver water due to the failure or damage of major water system components.	25%				

						Additional DCP											
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
HONEY GROVE	4/14/2014	WUG		Woodbine Aquifer	6	When the System water production exceeds 400,000 gpd for 2 (two) consecutive days or 350,000 gpd for 7 (seven) consecutive days, or when mechanical problems are present, such as line breaks, pump failures, ground storage levels are low, and clogged intakes.	10%	When System water production exceeds 450,000 gpd for 2 (two) consecutive days or 400,000 gpd for 7 (seven) consecutive days	20%	When the System water production exceeds 500,000 gpd for 2 (two) consecutive days or 450,000 gpd for 7 (seven) consecutive days	30%	When the System water production exceeds 550,000 gpd for 2 (two) consecutive days or 500,000 gpd for 7 (seven) consecutive days	40%	When the City of Honey Grove, Texas, or his/her designee, determines that a water supply emergency exists based on: 1. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or 2. Natural or man-made contamination of the water supply source(s).	50%	When the City of Honey Grove, Texas, or his/her designee, determines that a water supply emergency exists based on: 1. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or 2. Natural or man-made contamination of the water supply source(s).	
MINERAL WELLS	5/6/2014	WUG	PPCMWD #1	Lake Palo Pinto	4	1. Water stored in the Palo Pinto reservoir is equal to or less than 13,780 acre-feet or 860 ft. MSL (50% of storage capacity). 2. When the total daily water demand equals or exceeds 90% of the safe operating capacity of the system for three consecutive days or 95% of system capacity on a single day.	10%	1. Water stored in the Palo Pinto reservoir is equal to or less than 11,060 acre-feet or 858 ft. MSL (40% of storage capacity). 2. When total daily water demand equals or exceeds 100% of the safe operating capacity of the system for three consecutive days. 3. Any mechanical failure of pumping equipment which will require more than 24 hours to repair when a mild drought is in progress.	20%	1. Water stored in the Palo Pinto reservoir is equal to or less than 8,295 acre-feet or 856 ft. MSL (30% of storage capacity). 2. Average daily water consumption reaches 110% of production capacity for a 24-hour period. 3. Average daily water consumption will not enable storage levels to be maintained. 4. System demand exceeds available high service pump capacity. 5. Any mechanical failure of pumping equipment, which will require more than 12 hours to repair if a moderate drought is in progress.	25%	1. Water system is contaminated either accidentally or intentionally. Emergency condition is reached immediately upon detection. 2. Water system failure from acts of God (tornadoes, hurricanes) or man. Emergency condition is reached immediately upon detection. 3. Any interruption of water service through main water supply lines for more than 12-hours. Emergency condition is reached immediately upon detection. 4. Notification to the customers will be enacted at once and periodic updates will be conveyed through the news media on progress of emergency water conditions.					
MUENSTER	11/1/1999	WUG		Trinity Aquifer	6	When total daily water demand equals or exceeds 650,000 gallons for three consecutive days, or 800,000 gallons on a single day	10%	When total daily water demand equals or exceeds 650,000 gallons for five consecutive days, or 800,000 gallons on a single day	15%	When total daily water demand equals or exceeds 700,000 gallons for three consecutive days, or 800,000 gallons on a single day	20%	When total daily water demand equals or exceeds 750,000 gallons for three consecutive days, or 800,000 gallons on a single day	25%	When the Mayor or Mayor Pro Tem determines that a water supply emergency exists based on: (1) Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; or (2) Natural or man-made contamination of the water supply source(s).	Repair major water line breaks, or pump or system failures; or clean up the contamination, disinfect as necessary, and obtain a good bac-T test	When water shortage conditions threaten public health, safety, and welfare	

Additional DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
NEWARK	9/7/2000	WUG		Trinity Aquifer	6	When warranted by authority of the mayor as stated in this section.	10%	When the maximum demand per meter exceeds 350 gallons per day for seven consecutive days or when due to system repairs, excessive leakage or equipment malfunction.	20%	When the maximum demand per meter exceeds 450 gallons per day for six consecutive days or when due to system repairs, excessive leakage or equipment malfunction, or when ground storage tanks remain only 50% full for six consecutive days.	30%	When the maximum demand per meter exceeds 500 gallons per day for five consecutive days or when due to system repairs, excessive leakage or equipment malfunction, or when ground storage tanks remain only 40% full for five consecutive days.	40%	When the mayor determines that a water supply emergency exists based on: (A) Major water line breaks, or when pump or system failures occur, which cause unprecedented loss of capability to provide water service, or the water supply to the city is exceeded by the system usage demand for two consecutive days and storage tanks remain only 35% full for two consecutive days. (B) Natural or man-made contamination of the water supply source(s).	50%	When the maximum daily demand per meter exceeds 600 gallons per day for two consecutive days or due to system repairs, excessive leakage, equipment malfunction, power outages, natural disaster, or contamination of the water, or when the system demand exceeds the system supply for two consecutive days and ground storage facilities remain only 30% full for two consecutive days.	
PILOT POINT	5/12/2014	WUG		Trinity Aquifer	5	Every April 1st the City of Pilot Point will make a public announcement to its customers to practice water conservation going into the summer months.	3%	a) The City is unable to recover above approximately 90% ground storage; or b) Water usage exceeds pumping capabilities (unable to maintain elevated storage level).	10%	a) The City is unable to recover above approximately 80% ground storage; or b) Water usage exceeds pumping capabilities.	20%	a) The City is unable to recover above approximately 60% ground storage, or b) Water usage exceeds pumping capabilities.	40%	a) The failure of one or more wells; b) Major water line breaks, or pump or system failures, which cause unprecedented loss of capability to provide water service; or c) Natural or man-made contamination of the water supply source(s).			
RICE	2/3/2004	WUG	Rice WSC (Ennis, Corsicana)	Corsicana Sources Ennis Sources	3	1) Water consumption has reached 80 percent of daily maximum supply for three (3) consecutive days. 2) Water supply is reduced to a level that is only 20 percent greater than the average consumption for the previous month. 3) There is an extended period (at least eight (8) weeks) of low rainfall and daily use has risen 20 percent above the use for the same period during the previous year.		1) Water consumption has reached 90 percent of the amount available for three consecutive days. 2) The water level in any of the water storage tanks cannot be replenished for three (3) consecutive days. The highest recorded water level drops (12) feet or more for (3) consecutive days.		1) Failure of a major component of the system or an event which reduces the minimum residual pressure in the system below 20 psi for a period of 24 hours or longer. 2) Water consumption of 95 percent or more of the maximum available for three (3) consecutive days. 3) Water consumption of 100 percent of the maximum available and the water storage levels in the system drop during one 24-hour period. 4) Natural or man-made contamination of the water supply source(s). 5) The declaration of a state of disaster due to drought conditions in a county or counties served by the Corporation. 6) Reduction of wholesale water supply due to							

Additional DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	Plan Date	Entity Type	Wholesale Water Provider(s)	Source(s)	No. of Stages	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal	Trigger	Savings Goal
RICE, continued										drought conditions. 7) Other unforeseen events which could cause imminent health or safety risks to the public.							
SHERMAN	4/18/2014	WUG	GTUA	Lake Texoma, Trinity Aquifer, Woodbine Aquifer	4	•GTUA has initiated Stage 1 These triggers below are internal triggers which may cause the City to implement Stage 1 restrictions: When total daily water demand equals 80 percent or 18 mgd for five (5) consecutive days based on the "safe" operating capacity of water supply facilities.	5%	•GTUA has initiated Stage 2 These triggers below are internal triggers which may cause the City to implement Stage 2 restrictions: When water demands equal or exceed 90 percent, or 21 mgd for three (3) consecutive days based on the safe operating capacity of the facilities.	15%	•GTUA has initiated Stage 3 These triggers below are internal triggers which may cause the City to implement Stage 3 restrictions: When water demand equals 100% or 23 mgd for three (3) consecutive days based on the state operating capacity of the facilities	20%	When one or more of the following conditions exist: a) Natural or man-made contamination occurs in the water supply source(s) of Lake Texoma b) The City of Sherman experiences water production or distribution system limitations c) The City of Sherman experiences a system outage due to the failure or damage of major water system components					
SOUTH GRAYSON WSC	4/30/2014	WUG		Trinity Aquifer Woodbine Aquifer	5	Annually beginning on June 1st to September 30th.	15%	When SGWSC reaches 90% of pumping capacity for three consecutive days.	20%	When SGWSC exceeds 95% of pumping capacity for three consecutive days or equals or exceeds 100% of capacity on a single day.	25%		30%		40%		
TIOGA	12/1/2012	WUG		Trinity Aquifer	4	Daily water demand exceeds 316,800 gallons per day for three consecutive days (50% of rated capacity of all wells).	< 316,800 gpd	1) Daily water demand exceeds 380,160 gallons per day for three consecutive days (60% of capacity of all wells); or 2) water pressures in the distribution system remain below 40 psi for more than six consecutive hours; or 3) failure of any well, coupled with demand over 237,600 gpd (75% of capacity of the two smaller wells).	< 380,160 gpd	1) Daily water demand exceeds 475,200 gallons per day for three consecutive days (75% of rated capacity of all wells); or 2) imminent failure of a system component where immediate health or safety hazards exist; or 3) water pressures in the distribution system continue to drop after implementing management steps defined below.	< 475,200 gpd	When the Mayor determines that an emergency condition exists, due to contamination of the water source or system failures, he/she shall implement all portions of the severe response stage as deemed necessary.	< 316,800 gpd				
WHITEWRIGHT	7/5/2011	WUG		Woodbine Aquifer	4	• Demand exceeds 90% of the amount that can be delivered to customers for seven consecutive days • Water demand for all or part of the delivery system approaches delivery capacity because delivery capacity is inadequate • Supply source becomes contaminated • Water supply system is	0%	• Demand exceeds 95% of the amount that can be delivered to customers for three consecutive days • Water demand for all or part of the delivery system equals delivery capacity because delivery capacity is inadequate • Supply source becomes contaminated • Water supply system is	2%	• Demand exceeds 98% of the amount that can be delivered to customers for three consecutive days • Water demand for all or part of the delivery system exceeds delivery capacity because delivery capacity is inadequate • Supply source becomes contaminated • Water supply system is	5%	• Demand exceeds the amount that can be delivered to customers • Water demand for all or part of the delivery system seriously exceeds delivery capacity because the delivery capacity is inadequate • Supply source becomes contaminated • Water supply system	10%				

Additional DCP																	
						Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
Entity	**Plan Date**	**Entity Type**	**Wholesale Water Provider(s)**	**Source(s)**	**No. of Stages**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**	**Trigger**	**Savings Goal**
WHITEWRIGHT, continued						unable to deliver water due to the failure or damage of major water system components • Water demand is approaching the limit of the permitted supply		unable to deliver water due to the failure or damage of major water system components • Water demand is approaching the limit of the permitted supply		unable to deliver water due to the failure or damage of major water system components • Water demand is approaching the limit of the permitted supply		unable to deliver water due to the failure or damage of major water system components • Water demand is approaching the limit of the permitted supply					
WOODBINE WSC	5/13/2013	WUG		Trinity Aquifer	4	Stage I will begin: Every April 5th the utility will mail a public announcement to its customers.		Supply Based Triggers: 1) Water consumption has reached 85% of daily maximum supply for five consecutive days. Demand or Capacity Based Triggers: 1) Total daily demand has reached 85% of daily pumping capacity for five consecutive days.	10%	Supply Based Triggers: 1) Water consumption has reached 90% of daily maximum supply for three consecutive days. Demand or Capacity Based Triggers: 1) Failure of a major component of the system or an event which reduces the minimum residual pressure in the system below 30 psi for a period of 24 hours or longer. 2) Total daily demand has reached 90% of daily pumping capacity for three (3) consecutive days.	15%	Supply Based Triggers: 1) Water consumption has reached 95% of daily maximum supply for three consecutive days. Demand or Capacity Based Triggers: 1) Failure of a major component of the system or an event which reduces the minimum residual pressure in the system below 20 psi for a period of 24 hours or longer. 2) Total daily demand has reached 95 % of daily pumping capacity for three (3) consecutive days. 3) Natural or man-made contamination of the water supply. 4) The declaration of a state of disaster due to drought conditions in a county served by the Corporation 5) Other events which could cause imminent health or safety risks to the public.	20%				

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The drought management strategies for most suppliers include some sort of limitation on outdoor irrigation. It appears that many of the entities included measures for twice per week, once per week and no outdoor irrigation for the first three stages. This was a regional consistency initiative sponsored by the major suppliers. Table 7.2 shows statistics based on the analysis of the DCPs for measures that were included in more than 50 percent of the plans. Measures typically increase in number and/or restrictiveness as more severe drought stages are triggered. Reductions are predominantly defined in the DCPs as a percentage of water demand, with a limited number of entities setting quantified goals on unit reductions, percentage of seasonal water demand, or other factors.

Table 7.2
Statistics for Common Drought Contingency Plan Measures

Strategy	Percentage of Plans Specifying Strategy	Average Stage Initiated
No irrigation with hose-end sprinklers	95%	3.3
No irrigation with automatic irrigation systems	94%	3.5
No draining and filling of pools and spas	86%	3.1
Public awareness/ customer awareness measures	80%	1.0
Mandatory no more than twice per week irrigation limits	80%	1.5
Water rationing/ reductions by set percentages for commercial/ industrial customers	77%	3.6
Mandatory limit on irrigation hours	71%	1.5
Prohibit non-essential water uses - hosing of paved areas	69%	2.2
Mandatory no more than once per week irrigation limits	69%	2.3
Prohibit non-essential water uses - flushing gutters, allowing runoff, not repairing leaks	67%	1.9
Use alternative supply sources	61%	2.7
No vehicle washing outside commercial facilities	60%	3.2
No operation of ornamental fountains/ ponds	59%	3.0
Vehicle washing only with bucket and/or handheld hose with shutoff nozzle (outside of commercial facilities)	56%	1.9
Prohibit non-essential water uses - hosing of buildings or other structures except for fire protection	56%	2.1
No irrigation of golf course fairways	55%	3.6
No new permits for swimming pools, Jacuzzis, spas, ornamental ponds, or fountains	55%	3.3
No irrigation by hand-watering, with soaker hoses, or by drip irrigation	53%	3.8
Voluntary usage reductions	52%	1.0
Prohibit non-essential water uses - wet street sweeping	52%	1.9
Investigate alternative water sources	52%	1.7

7.2.5 Effectiveness of Drought Response Measures and Challenges in Quantification

The information available to the RWPG through survey responses and submitted DCP documents does not quantify the historical or potential reductions in water use associated with implementation of the DCPs. However, many suppliers have seen reductions in per capita water use since the implementation of drought stages since 2011.

7.3 Existing and Potential Emergency Interconnects

In accordance with the requirements of Texas Water Development Board (TWDB) and the Texas Administrative Code, the RCWPG was required to collect information on existing water infrastructure that may be used for emergency interconnects. To meet this requirement, Region C included a question regarding this on the WUG survey and asked for this information during WWP meetings. Information was requested regarding interconnect relationships, facilities, general locations, and supply volumes and sources. The data obtained on emergency interconnects was presented to a subcommittee of the Region C Water Planning Group, approved at the April 20, 2015, and submitted to the TWDB separately from the Regional Water Plan.

In reviewing Drought Contingency Plans submitted to Region C, a number of non-confidential emergency interconnects (existing and potential) were found. They are: Bonham interconnection with Bois d'Arc MUD, Saginaw emergency connections to current supplier (Fort Worth) at two alternate locations, River Oaks emergency interconnection with Fort Worth for treated water, Walnut Creek SUD emergency interconnections with Community WSC and Azle, Dallas County Park Cities MUD interconnection with Dallas, Red River Authority emergency interconnects with an unspecified number of small entities, Grand Prairie's emergency interconnections with Arlington and Mansfield, Pilot Point potential interconnection with Mustang SUD, East Cedar Creek FWSD potential interconnection with viable public water entities, and Woodbine WSC potential interconnection with unspecified water supplier.

7.4 Emergency Responses to Local Drought Conditions or Loss of Municipal Supply

In addition to regional or statewide droughts, entities may be subject to localized drought conditions or loss of existing water supplies due to infrastructure failure, temporary water quality impairment, or other unforeseen conditions. Loss of existing supplies, while relatively uncommon, is particularly challenging to address as the causes are often difficult to anticipate. Numerous entities within Region

C have DCPs which include an emergency response stage and corresponding measures for droughts exceeding the DOR or for other emergency water supply conditions. Some entities, including a number of WWPs, also have emergency action plans which establish procedures for responding rapidly and effectively to emergency conditions.

Because it is not possible for water providers to predict all emergency conditions and because responses or repairs may require an extended period of time, it is important to consider the range of options for emergency water supply sources available under emergency conditions. A high-level analysis of options was performed to assess potential emergency water supply options for WUGs in Region C with estimated Year 2010 population of 7,500 or less that rely on a sole source for is existing supply, as well as for all County-Other WUGs (these parameters were set forth in the scope of work for regional planning). Consideration of emergency supply options for these entities is particularly important as many smaller WUGs may not have existing access to backup supplies through interconnect facilities with adjacent systems. Applicable WUGs were characterized by projected Year 2020 population, Year 2020 demand, existing supply source type (surface water, groundwater, or blend), and other WUG-specific information. These characteristics were then used to identify potentially feasible emergency supply options and associated infrastructure requirements. The results of this analysis are shown in Table 7.3**.**

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Table 7.3
Potential Emergency Supply Options

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
ALVORD	WISE	1,625	110	NO	NO	NO	NO	NO	YES	YES	YES	-	-	**Emergency Interconnect:** Conveyance Facilities; **Other Named Local Supply:** Conveyance facilities, Treatment facility; **Trucked in Water:** none.	**Emergency Interconnect:** City of Chico, Montague Water Systems, West Wise SUD, City of Decatur, Bolivar WSC; **Other Named Local Supply:** Big Sandy Creek, Denton Creek, Lake Amon Carter	City of Chico, Montague Water Systems, West Wise SUD, City of Decatur, Bolivar WSC	NO	
ANNETTA	PARKER	1,678	152	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well**: Conveyance Infrastructure; **Emergency Interconnect:** Conveyance Infrastructure; **Other Named Local Supply:** Conveyance Infrastructure, Treatment Facility; **Trucked in Water:** none.	**Release from Upstream Reservoir:** Lake Weatherford; **Local Groundwater Well**: Trinity Aquifer; **Emergency Interconnect:** City of Aledo, Aledo Mobile Home Park, City of Weatherford, City of Hudson Oaks, City of Willow Park; Other Named Local Supply: Town Creek, Clear Fork Trinity River	**Emergency Interconnect:** City of Aledo, Aledo Mobile Home Park, City of Weatherford, City of Hudson Oaks, City of Willow Park	NO	
ANNETTA NORTH	PARKER	559	67	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance Infrastructure; **Emergency Interconnect:** Conveyance Infrastructure; **Other Named Local Supply:** Conveyance Infrastructure, Treatment Facility; **Trucked in Water:** none.	**Release from Upstream Reservoir:** Lake Weatherford; **Local Groundwater Well**: Trinity Aquifer; **Emergency Interconnect:** City of Aledo, Aledo Mobile Home Park, City of Weatherford, City of Hudson Oaks, City of Willow Park	**Emergency Interconnect:** City of Aledo, Aledo Mobile Home Park, City of Weatherford, City of Hudson Oaks, City of Willow Park	NO	
ANNETTA SOUTH	PARKER	526	63	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance Infrastructure; **Emergency Interconnect:** Conveyance Infrastructure; **Other Named Local Supply:** Conveyance Infrastructure, Treatment Facility; **Trucked in Water:** none.	**Release from Upstream Reservoir:** Lake Weatherford; Local **Groundwater Well**: Trinity Aquifer; **Emergency Interconnect:** City of Aledo, Aledo Mobile Home Park, City of Weatherford, City of Hudson Oaks, City of Willow Park	**Emergency Interconnect:** City of Aledo, Aledo Mobile Home Park, City of Weatherford, City of Hudson Oaks, City of Willow Park	NO	
BETHEL-ASH WSC	Henderson, Henderson, Van Zandt	6,239	637	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Carrizo-Wilcox Aquifer, Queens City Aquifer, Sparta Aquifer; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** City of Eustace, Athens Land Company, Lakeshore Utility Co Inc., Crescent Heights WSC, Rick Brown, Virginia WSC, Leagueville WSC, Monarch Utilities, Martin Mill WSC, Little Hope-Moore WSC Macbee SUD, Toe WSC; **Other Named Local Supply:** Cream Level Creek, Little Duncan Branch, One Mile Creek, Lake Athens, Cedar Creek Reservoir; **Trucked in Water:** Unknown	City of Eustace, Athens Land Company, Lakeshore Utility Co Inc., Crescent Heights WSC, Rick Brown, Virginia WSC, Leagueville WSC, Monarch Utilities, Martin Mill WSC, Little Hope-Moore WSC Macbee SUD, Toe WSC	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
BLUE MOUND	TARRANT	2,398	191	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** City of Fort Worth; **Other Named Local Supply:** Little Fossil Creek; Trucked in Water: Unknown	City of Fort Worth	NO	
BLUE RIDGE	COLLIN	925	92	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** Frognot WSC, Verona WSC, Westminster; **Other Named Local Supply:** Pilot Grove Creek; **Trucked in Water:** Unknown	Frognot WSC, Verona WSC, Westminster	NO	
BRANDON-IRENE WSC	Ellis, Navarro, Hill	2,231	296	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Navarro Mills Lake; **Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** Files Valley WSC, South Ellis County WSC, Navarro Mills WSC, Post Oak SUD, City of Malone, City of Bynum, Chatt WSC, City of Hillsboro; **Other Named Local Supply:** Richard Creek, Navarro Mills, Mill Creek; **Trucked in Water:** Unknown	Files Valley WSC, South Ellis County WSC, Navarro Mills WSC, Post Oak SUD, City of Malone, City of Bynum, Chatt WSC, City of Hillsboro	NO	
COLLINSVILLE	GRAYSON	2,117	233	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Ray Roberts Lake; **Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** Two Way SUD, City of Tioga, Kiowa Homeowners WSC; **Other Named Local Supply:** Ray Roberts Lake; **Trucked in Water:** Unknown	Two Way SUD, City of Tioga, Kiowa Homeowners WSC	NO	
COUNTY-OTHER	COLLIN	10,289	1,613	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	COOKE	8,500	1,123	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
COUNTY-OTHER	DALLAS	5,339	3,106	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	DENTON	30,207	3,785	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	ELLIS	6,100	745	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	FANNIN	13,168	1,466	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	FREESTONE	11,719	1,208	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	GRAYSON	21,617	2,746	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	HENDERSON	3,424	314	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
COUNTY-OTHER	JACK	4,307	482	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	KAUFMAN	15,829	1,742	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	NAVARRO	5,475	623	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	PARKER	54,108	7,027	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	ROCKWALL	3,527	568	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	TARRANT	36,012	8,008	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	
COUNTY-OTHER	WISE	30,543	3,667	NO	NO	YES	NO	NO	NO	NO	YES	-	-	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** ; **Trucked in Water:** None	**Release from Upstream Reservoir:** ; **Local Groundwater Well:** ; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** ; **Other Named Local Supply:** ; **Trucked in Water:** Unknown		NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
CRESSON	Hood (G), Johnson (G), Parker	977	148	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Lake Granbury; **Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** New Progress WSC, Bluebonnet WSC, Johnson County SUD, Monarch Utilities LP, Aqua Texas Inc.; **Other Named Local Supply:** Walnut Creek, Rucker Creek; **Trucked in Water:** Unknown	New Progress WSC, Bluebonnet WSC, Johnson County SUD, Monarch Utilities LP, Aqua Texas Inc.	NO	
ECTOR	FANNIN	773	87	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine; **Emergency Interconnect:** Southwest Fannin SUD; **Trucked in Water:** Unknown	Southwest Fannin SUD	NO	
EUSTACE	HENDERSON	1,100	119	YES	NO	YES	YES	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Cedar Creek Reservoir; Local Groundwater Well: Carrizo-Wilcox Aquifer; **Emergency Interconnect:** Bethel-Ash WSC, Athens Land Company, Payne Springs WSC, East Cedar Creek FWSD, City of Mabank, Quality Water of East Texas; **Other Named Local Supply:** Cedar Creek Reservoir; **Trucked in Water:** Unknown	Bethel-Ash WSC, Athens Land Company, Payne Springs WSC, East Cedar Creek FWSD, City of Mabank, Quality Water of East Texas	NO	
FLO COMMUNITY WSC	Freestone, Leon	4,437	337	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Carrizo-Wilcox Aquifer, Queen City and Sparta Aquifer; **Curtailment of Upstream/Downstream Water Rights:** ; **Emergency Interconnect:** South Freestone WSC, Butler WSC, St. Paul Shiloh-Timesville WSC, Consolidation WSC, Southeast WSC, Concord Robbins WSC; **Other Named Local Supply:** Upper Keechi Creek; **Trucked in Water:** Unknown	South Freestone WSC, Butler WSC, St. Paul Shiloh-Timesville WSC, Consolidation WSC, Southeast WSC, Concord Robbins WSC	NO	
GUNTER	GRAYSON	2,200	355	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Marilee SUD; **Other Named Local Supply:** Little Elm Creek; **Trucked in Water:** Unknown	Marilee SUD	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
HICKORY CREEK SUD	Collin, Fannin, Hunt (D)	4,517	451	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Lake Tawakoni; **Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer, Nacatoch Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Frognot WSC, West Leonard WSC, City of Leonard, Southwest Fannin County SUD, Arledge Ridge WSC, City of Wolfe City, North Hunt SUD, Jacobia WSC, City of Greenville, Caddo Basin SUD; **Other Named Local Supply:** Hickory Creek, Tidwell Creek, Horse Creek, Honey Creek; **Trucked in Water:** Unknown	Frognot WSC, West Leonard WSC, City of Leonard, Southwest Fannin County SUD, Arledge Ridge WSC, City of Wolfe City, North Hunt SUD, Jacobia WSC, City of Greenville, Caddo Basin SUD	NO	
HONEY GROVE	FANNIN	1,700	274	NO	YES	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; Groundwater field near the intersection of Hwy 82 and 100th St. **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Bois D' Arc MUD, Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Bois D' Arc MUD, Lamar County Water Supply District, Dial WSC, Mccraw Chapel WSC; **Trucked in Water:** Unknown	Bois D' Arc MUD, Lamar County Water Supply District, Dial WSC, Mccraw Chapel WSC	YES	
JACKSBORO	JACK	4,863	681	YES	YES	NO	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Bridgeport Reservoir; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City of Bryson, Walnut Creek SUD; **Other Named Local Supply:** West Fork Trinity River, Bridgeport Reservoir; **Trucked in Water:** Unknown	City of Bryson, Walnut Creek SUD	NO	
KENTUCKY TOWN WSC	GRAYSON	2,945	367	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City if Towm Bean, Pink Hill WSC, City of Bells, Southwest Fannin County SUD, City of Whitewright, South Grayson WSC, Luella WSC; **Other Named Local Supply:** Bois D' Arc Creek, Corneliason Creek; **Trucked in Water:** Unknown	City if Towm Bean, Pink Hill WSC, City of Bells, Southwest Fannin County SUD, City of Whitewright, South Grayson WSC, Luella WSC	NO	
LAKE KIOWA SUD	COOKE	2,209	786	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Woodbine WSC; **Trucked in Water:** Unknown	Woodbine WSC	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
LADONIA	FANNIN	1,600	120	YES	NO	YES	YES	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Cooper Lake; **Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect: Mccraw Chapel WSC, DIAL WSC, Delta County MUD, North Hunt SUD, Bartley WSC, Arledge Ridge WSC, City of Dodd City, Town of Windom**; **Other Named Local Supply:** North Sulphur River, Pecan Creek, Middle Sulphur River; **Trucked in Water:** Unknown	Mccraw Chapel WSC, DIAL WSC, Delta County MUD, North Hunt SUD, Bartley WSC, Arledge Ridge WSC, City of Dodd City, Town of Windom	NO	
LAKESIDE	TARRANT	1,350	227	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Aqua Texas Inc., City of Fort Worth; **Trucked in Water:** Unknown	Aqua Texas Inc., City of Fort Worth	YES	
LAKEWOOD VILLAGE	DENTON	692	83	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Aqua Texas Inc., Lake Cities MUA, Community Water Service Inc. Denton County FWSD; **Trucked in Water:** Unknown	Aqua Texas Inc., Lake Cities MUA, Community Water Service Inc. Denton County FWSD	NO	
LEONARD	FANNIN	2,213	331	NO	NO	YES	YES	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Southwest Fannin County SUD, Hickory Creek SUD, West Leonard WSC, Arledge Ridge WSC; **Trucked in Water:** Unknown	Southwest Fannin County SUD, Hickory Creek SUD, West Leonard WSC, Arledge Ridge WSC	NO	
LINDSAY	COOKE	1,102	144	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Ray Roberts Lake; **Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Myra Water System, City of Muenster, City of Gainesville, Bolivar WSC, ERA WSC; **Other Named Local Supply:** Elm Fork Trinity River; **Trucked in Water:** Unknown	Myra Water System, City of Muenster, City of Gainesville, Bolivar WSC, ERA WSC	NO	
LOG CABIN	HENDERSON	777	80	NO	NO	YES	YES	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Carrizo-Wilcox Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Lakeshore Utility Co Inc., Monarch	Lakeshore Utility Co Inc., Monarch Utilities LP	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
LOG CABIN, continued															Utilities LP; **Trucked in Water:** Unknown			
LUELLA WSC	GRAYSON	3,800	400	NO	NO	YES	YES	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City of Sherman, Pink Hill WSC, Kentuckytown WSC, South Grayson WSC, City of Howe; **Other Named Local Supply:** Deaver Creek; **Trucked in Water:** Unknown	City of Sherman, Pink Hill WSC, Kentuckytown WSC, South Grayson WSC, City of Howe	NO	
MCLENDON-CHISHOLM	ROCKWALL	1,739	330	NO	NO	YES	YES	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Blackland WSC, Poetry WSC, City of Terrell, Lawrence WSC, Kaufman Co Dev District 1, City of Forney, Forney Lake WSC, City of Heath; **Other Named Local Supply:** Buffalo Creek; **Trucked in Water:** Unknown	Blackland WSC, Poetry WSC, City of Terrell, Lawrence WSC, Kaufman Co Dev District 1, City of Forney, Forney Lake WSC, City of Heath	NO	
MUENSTER	COOKE	1,550	266	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Ray Roberts Lake; **Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Forestburg WSC, City of Gainesville, City of Lindsay, Myra Water System, Bolivar WSC; **Other Named Local Supply:** Elm Fork Trinity River; **Trucked in Water:** Unknown	Forestburg WSC, City of Gainesville, City of Lindsay, Myra Water System, Bolivar WSC	NO	
NAVARRO MILLS WSC	NAVARRO	3,308	352	YES	NO	YES	YES	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Richland Chambers Reservoir; **Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** South Ellis County WSC, City of Frost, Avalon Water & Sewer SVC Corp, City of Blooming Grove, City of Corsicana, Corbet WSC, Community Water Company, Post Oak SUD, Brandon-Irene WSC; **Other Named Local Supply:** Richland Creek; **Trucked in Water:** Unknown	South Ellis County WSC, City of Frost, Avalon Water & Sewer SVC Corp, City of Blooming Grove, City of Corsicana, Corbet WSC, Community Water Company, Post Oak SUD, Brandon-Irene WSC	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
NEW FAIRVIEW	WISE	1,597	163	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Grapevine Lake; **Local Groundwater Well:** X; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Aqua Texas Inc., Longhorn Company, City of Justin, City of Rhome; **Other Named Local Supply:** Trail Creek, Denton Creek; **Trucked in Water:** Unknown	Aqua Texas Inc., Longhorn Company, City of Justin, City of Rhome	NO	
NEWARK	WISE	1,772	195	NO	NO	YES	YES	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City of Rhome; **Trucked in Water:** Unknown	City of Rhome	NO	
NORTH HUNT WSC	Fannin, Delta (D), Hunt (D)	4,246	287	YES	NO	YES	YES	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Cooper Lake; **Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City of Wolfe City, Arledge Ridge WSC, Bartley Woods WSC, Town of Windom, Mccraw Chapel WSC, City of Ladonia, Delta County MUD, West Delta WSC, City of Commerce, Maloy WSC, Campbell WSC, Jacobia WSC, City of Greenville, Hickory Creek SUD; **Other Named Local Supply:** Pecan Creek, Middle Sulphur River, Upper Sulphur River, Cooper lake; **Trucked in Water:** Unknown	City of Wolfe City, Arledge Ridge WSC, Bartley Woods WSC, Town of Windom, Mccraw Chapel WSC, City of Ladonia, Delta County MUD, West Delta WSC, City of Commerce, Maloy WSC, Campbell WSC, Jacobia WSC, City of Greenville, Hickory Creek SUD	NO	
OAKWOOD	FREESTONE	40	7	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Carrizo-Wilcox Aquifer, Queen City Aquifer, Sparta Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Butler WSC, Tucker WSC, Anderson county Cedar Creek WSC, Consolidated WSC, St Paul Shiloh-Timesville WSC, City of Buffalo, South Freestone WSC; **Other Named Local Supply:** Toms Creek, Upper Keechi Creek, Trinity River; **Trucked in Water:** Unknown	Butler WSC, Tucker WSC, Anderson county Cedar Creek WSC, Consolidated WSC, St Paul Shiloh-Timesville WSC, City of Buffalo, South Freestone WSC	NO	
PANTEGO	TARRANT	2,400	621	NO	NO	YES	YES	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City of Dalworthington Gardens, City of Arlington; **Other Named Local Supply:** Kee Branch; **Trucked in Water:** Unknown	City of Dalworthington Gardens, City of Arlington	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
PELICAN BAY	TARRANT	1,575	106	YES	NO	YES	YES	NO	YES	NO	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Lake Worth; **Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City of Azle, City of Fort Worth, Community WSC; **Trucked in Water:** Unknown	City of Azle, City of Fort Worth, Community WSC	NO	
SAVOY	FANNIN	924	88	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Southwest Fannin County SUD; **Trucked in Water:** Unknown	Southwest Fannin County SUD	NO	
SOUTHWEST FANNIN COUNTY SUD	Fannin, Grayson	5,628	559	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Starr WSC, Oak Ridge-South Gale WSC, City of bells, City of Savoy, Ravenna Nunnelee WSC, City of Bonham, Randolph WSC, Arledge Ridge WSC, West Leonard WSC, Desert WSC, City of Trenton, City of Whitewright, Kentuckytown WSC; **Other Named Local Supply:** Bois D' Arc Creek, Corneliason Creek, Red River; **Trucked in Water:** Unknown	Starr WSC, Oak Ridge-South Gale WSC, City of bells, City of Savoy, Ravenna Nunnelee WSC, City of Bonham, Randolph WSC, Arledge Ridge WSC, West Leonard WSC, Desert WSC, City of Trenton, City of Whitewright, Kentuckytown WSC	NO	
TIOGA	GRAYSON	865	119	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City of Collinsville,, Two Way SUD, Marilee SUD, City of Celina, Mustang SUD, City of Pilot Point; **Trucked in Water:** Unknown	City of Collinsville,, Two Way SUD, Marilee SUD, City of Celina, Mustang SUD, City of Pilot Point	NO	
TOM BEAN	GRAYSON	1,176	222	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Kentuckytown WSC; **Trucked in Water:** Unknown	Kentuckytown WSC	NO	
TRENTON	FANNIN	706	131	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Southwest Fannin County SUD, Desert WSC; **Trucked in Water:** Unknown	Southwest Fannin County SUD, Desert WSC	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
TRINIDAD	HENDERSON	886	91	NO	YES	YES	YES	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Carrizo-Wilcox Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** West Cedar Creek MUD, Community Water Company, Monarch Utilities Lp, Fishermans Wharf Water System, Crescent heights WSC, Aqua Texas Inc., CRC WSC, Chatfield WSC, City of Kerens; **Other Named Local Supply:** Trinity River, Cedar Creek Reservoir; **Trucked in Water:** Unknown	West Cedar Creek MUD, Community Water Company, Monarch Utilities Lp, Fishermans Wharf Water System, Crescent heights WSC, Aqua Texas Inc., CRC WSC, Chatfield WSC, City of Kerens	YES	
TWO WAY SUD	Cooke, Grayson	6,394	710	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Lake Texoma; **Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Northwest Grayson Co WCID 1, City of Southmayd, City of Pottsboro, City of Denison, Lass Water Company, City of Dorchester, City of Tioga, City of Collinsville, Woodbine WSC, City of Whitesboro, Callisburg WSC; **Other Named Local Supply:** Big Mineral Creek, Mustang Creek Deaver Creek, Lake Texoma; **Trucked in Water:** Unknown	Northwest Grayson Co WCID 1, City of Southmayd, City of Pottsboro, City of Denison, Lass Water Company, City of Dorchester, City of Tioga, City of Collinsville, Woodbine WSC, City of Whitesboro, Callisburg WSC	NO	
VALLEY VIEW	COOKE	820	56	NO	NO	YES	NO	NO	YES	NO	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Bolivar WSC; **Trucked in Water:** Unknown	Bolivar WSC	NO	
VIRGINIA HILL WSC	Henderson, Henderson (I)	4,351	420	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Carrizo-Wilcox Aquifer, queen City Aquifer, Sparta Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** CRC WSC, Aqua Texas Inc., Rick Brown, Bethel-Ash WSC, Leagueville WSC, Moore Station WSC, Monarch utilities LP, Poynor Community WSC, Brushy Creek WSC, BBS WSC; **Other Named Local Supply:** Caddo Creek; **Trucked in Water:** Unknown	CRC WSC, Aqua Texas Inc., Rick Brown, Bethel-Ash WSC, Leagueville WSC, Moore Station WSC, Monarch utilities LP, Poynor Community WSC, Brushy Creek WSC, BBS WSC	NO	
WESTON	COLLIN	3,370	506	NO	NO	YES	YES	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine WSC; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Marilee SUD, City of Anna, South Grayson WSC, Danville WSC, City of Celina; **Other Named Local Supply:**	Marilee SUD, City of Anna, South Grayson WSC, Danville WSC, City of Celina	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
WESTON, continued															East Fork Trinity River; **Trucked in Water:** Unknown			
WHITESBORO	GRAYSON	3,834	469	YES	NO	YES	NO	NO	YES	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Lake Texoma; **Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Two Way SUD; **Other Named Local Supply:** Big Mineral Creek; **Trucked in Water:** Unknown	Two Way SUD	NO	
WHITEWRIGHT	Fannin, Grayson	1,605	222	NO	NO	YES	NO	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Trinity Aquifer, Woodbine Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Southwest Fannin County SUD, Desert WSC, South Grayson WSC, Kentuckytown WSC; **Other Named Local Supply:** Bois D' Arc Creek; **Trucked in Water:** Unknown	Southwest Fannin County SUD, Desert WSC, South Grayson WSC, Kentuckytown WSC; Other Named Local Supply: Bois D' Arc Creek	NO	
WILLOW PARK	PARKER	4,877	759	YES	NO	YES	NO	NO	NO	YES	YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Benbrook Lake; **Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** City of Weatherford (in negotiations), Walnut Creek SUD, Aqua Texas Inc., New Progress WSC, Rolling Hills Estates WSC, Palo Duro Services Company Inc., City of Fort Worth, City of Aledo, Town of Annetta, Highland WSC, City of Hudson Oaks; **Other Named Local Supply:** Clear Fork Trinity River; **Trucked in Water:** Unknown	Emergency Interconnect: City of Weatherford (in negotiations), Walnut Creek SUD, Aqua Texas Inc., New Progress WSC, Rolling Hills Estates WSC, Palo Duro Services Company Inc., City of Fort Worth, City of Aledo, Town of Annetta, Highland WSC, City of Hudson Oaks	YES	
WOODBINE WSC	Cooke, Grayson	6,215	660		NO	YES	NO	NO			YES	-	-	**Release from Upstream Reservoir:** Conveyance facilities; **Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Release from Upstream Reservoir:** Lake Texoma; **Local Groundwater Well:** Trinity Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** R & N enterprises, Oak Ridge ventures Inc., Callisburg WSC, Two Way SUD, City of Collinville, Mountain Springs WSC City of Gainesville; **Other Named Local Supply:** Big Mineral Creek; **Trucked in Water:** Unknown	R & N enterprises, Oak Ridge ventures Inc., Callisburg WSC, Two Way SUD, City of Collinville, Mountain Springs WSC City of Gainesville	NO	

Water User Group Name	County	2020 Population	2020 Demand (AF/Year)	Release from upstream reservoir	Curtailment of upstream/downstream water rights	Local groundwater well	Brackish groundwater limited treatment	Brackish groundwater desalination	Emergency interconnect	Other named local supply	Trucked-in water	(Other)	(Other)	Type of infrastructure required	Entity providing supply	Other local entities required to participate/coordinate	Emergency agreements/ arrangements already in place?	Other
WORTHAM	FREESTONE	1,175	168	NO	NO	YES	YES	NO	YES	YES	YES	-	-	**Local Groundwater Well:** Conveyance facilities, Treatment Facilities; **Emergency Interconnect:** Conveyance facilities; **Other Named Local Supply:** Conveyance facilities, Treatment Facilities; **Trucked in Water:** None	**Local Groundwater Well:** Carrizo-Wilcox Aquifer; **Curtailment of Upstream/Downstream Water Rights:** X; **Emergency Interconnect:** Corbet WSC, Pleasant Grove WSC, Point enterprise WSC, City of Mexia, White Rock WSC, Post Oak SUD; **Other Named Local Supply:** Tehuacanna Creek; **Trucked in Water:** Unknown	Corbet WSC, Pleasant Grove WSC, Point enterprise WSC, City of Mexia, White Rock WSC, Post Oak SUD	NO	

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7.5 Region-Specific Drought Response Recommendations

7.5.1 Drought Response Recommendation for Surface Water

The RCWPG acknowledges that the DCPs for surface water suppliers provide the best drought management tools for surface supplies and recommends that the DCPs developed by the operators of these supplies serve as the RCWPG triggers for surface water. The RCWPG also recognizes that these triggers are subject to change as providers periodically reassess their needs and encourages both wholesale providers and other entities using surface water to examine their DCPs regularly. In particular, reservoirs are a major source of surface water in Region C, and drought triggers for direct providers and direct users of surface water in Region C are typically tied to reservoir levels or storage volume.

7.5.2 Drought Response Recommendation for Groundwater and Other Sources

Region C has historically relied primarily on surface water sources for most of its supply. Only a small percentage of the overall supply in the region comes from groundwater sources. Groundwater production is generally local to points of use, and aquifer properties vary spatially. Likewise, the characteristics of other sources such as reuse are specific to the associated supplier. As such, many providers using these sources have developed their DCPs in the context of their individual supply portfolios. The RCWPG acknowledges that the DCPs for groundwater suppliers are the best drought management tools for groundwater supplies and recommends that the DCPs developed by the operators of these supplies serve as the RCWPG triggers for groundwater. The RCWPG also recognizes that these triggers are subject to change as providers periodically reassess their needs and encourage both wholesale providers and other entities to examine their DCPs regularly.

The RCWPG recommends that water providers regularly review the U.S. Drought Monitor (http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?TX) as a tool for tracking drought conditions and in drought planning efforts leading up to drought measure implementation. The drought monitor is easily accessible, regularly updated, and does not require entities to directly monitor specific sources to benefit from its information. Its simplicity also facilitates its use in communicating drought conditions to customers and other water users. Table 7.4 shows the categories of the U.S. Drought Monitor with corresponding Palmer Drought Severity Index values.

Table 7.4
U.S. Drought Monitor Categories

Category	Description	Possible Impacts	Palmer Drought Index
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

The RCWPG recommends the following actions based on each of the drought classifications listed:

- Abnormally Dry – Entities should begin to review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage is necessary.
- Moderate Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage is necessary.
- Severe Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies may not be sufficient to meet reduced demands the entity should begin considering alternative supplies.
- Extreme Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage

is necessary. At this point if the review indicates current supplies may not be sufficient to meet reduced demands the entity should consider alternative supplies.

- Exceptional Drought – Entities should review their DCP, status of current supplies and current demands to determine if implementation of a DCP stage or changing to a more stringent stage is necessary. At this point if the review indicates current supplies are not sufficient to meet reduced demands the entity should implement alternative supplies.

7.5.3 Recommendations for Entities Not Required to Submit a DCP

While wholesale suppliers, retail public water suppliers, and irrigation districts are required to have a DCP, there are a number of users such as industrial operations and individual irrigators which are not. While some of these users receive water from providers with established drought management procedures, all water users are subject to the impacts of drought. For entities not required to have a DCP and not under the DCP of a supplier, the RCWPG recommends that they consider developing a DCP based on the model plan provided on the Region C website http://www.regioncwater.org/Documents/Model_Drought_Plan.pdf. In addition the RCWPD recommends that these entities regularly monitor drought conditions in order to facilitate decision making processes. Several resources are available to water users for monitoring drought. For users which receive water from an outside supplier, communication with their supplier and notifications of anticipated or implemented drought stages is a key resource. The following references are also recommended for consideration when planning for or experiencing drought:

- Palmer Drought Severity Index: http://www.drought.gov/drought/content/products-current-drought-and-monitoring-drought-indicators/palmer-drought-severity-index
- U.S. Drought Monitor (Texas detail): http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?TX
- TCEQ drought information: http://www.tceq.state.tx.us/response/drought/drought.html
- TWDB drought information: http://waterdatafortexas.org/drought/
- Texas Drought Preparedness Council: http://www.txdps.state.tx.us/dem/CouncilsCommittees/droughtCouncil/stateDroughtPrepCouncil.htm

7.5.4 Model Drought Contingency Plans

Model drought contingency plans addressing the requirements of 30 TAC §288(b) were developed for Region C and are available online at http://www.regioncwater.org/Documents/Model_Drought_Plan.pdf. Model plans were developed for municipal providers, wholesale water providers, irrigation users, and steam electric water users. These model plans were largely based on templates provided by the TCEQ, with several modifications made to elaborate on notification procedures, provide consistency with region-wide efforts to have three standard stage, and incorporate other components.

7.6 Drought Management WMS

The RCWPG does not support the recommendation of drought management measures as WMS in the Region C RWP. Such measures are not designed to address long-term growth in demands but, rather, are inherently temporary strategies intended to conserve water supplies or reduce adverse impacts during times of drought or emergency and are not active under more hydrologically favorable conditions. Drought management measures would not be implemented until well into a drought of record and would be lifted shortly after the drought has subsided. Because drought management is only active and beneficial under certain periods of time, its reliable yield is essentially zero when considered in an analogous manner to surface water, groundwater, reuse, or conservation. Also, as discussed previously, the efficacy of individual drought response measures is difficult to quantify and can vary considerably from one entity to another and one drought to another due to hydrologic and human factors. This creates additional uncertainty in the use of drought response as a reliable measure for addressing water needs. While drought management measures are not included as WMS in the Region C RWP, drought management is an important component of water supply management. The RCWPG supports implementation of DCPs under appropriate conditions by water providers in order to prolong supply availability and reduce impacts to water users and local economies.

7.7 Other Recommendations

7.7.1 Texas Drought Preparedness Council

The Texas Drought Preparedness Council is composed of representatives from multiple State agencies and plays an important role in monitoring drought conditions, advising the governor and other groups on significant drought conditions, and facilitating coordination among local, State, and federal agencies in drought-response planning. The Council meets regularly to discuss drought indicators and conditions across the state and releases Situation Reports summarizing their findings. https://www.txdps.state.tx.us/dem/CouncilsCommittees/droughtCouncil/stateDroughtPrepCouncil.htm

Additionally, the Council has developed the State Drought Preparedness Plan, which sets forth a framework for approaching drought in an integrated manner in order to minimized impacts to people and resources. The RCWPG supports the ongoing efforts of the Texas Drought Preparedness Council and recommends that water providers and other interested parties regularly review the Situation Reports as part of their drought monitoring procedures. The Council provided two recommendations to all RWPGs which are addressed in this chapter.

- Follow the outline template for Chapter 7 provided to the regions by the Texas Water Development Board.
- Evaluate the drought preparedness impacts of unanticipated population growth or industrial growth within the region over the planning horizon.

To meet these recommendations the RCWPG has developed this chapter to correspond with the sections of the outline template. The planning group also attempted to included Management Supply Factors (or "safety factors") for the major water suppliers that develop sources of supply within the region to address the uncertainty of unanticipated population growth or industrial growth over the planning horizon.

7.7.2 Development, Content, and Implementation of DCPs

The RCWPG recognizes that the DCPs developed by water providers in the Region are the best available tools for drought management, and makes the following recommendations to providers regarding development, content, and implementation of DCPs:

- In addition to any monitoring procedures included in the DCP, regular monitoring of resources and information from TCEQ, TWDB, the Texas Drought Preparedness Council, and the U.S. Drought Monitor.
- Coordination with wholesale providers regarding drought conditions and potential implementation of drought stages, particularly during times of limited precipitation.
- Review of the DCP by appropriate water provider representatives, particularly during times of limited precipitation.
- Regular consideration of updates to the DCP document to accommodate changes in supply source, infrastructure, water demands, or service area.
- Communication with customers during times of decreased supply or precipitation in order to facilitate potential implementation of drought measures and reinforce the importance of compliance with any voluntary measures.
- Designation of appropriate resources to allow for consistent application of enforcement procedures as established in the DCP

8 Unique Stream Segments, Unique Reservoir Sites, and Legislative Recommendations

Regional Water Planning Guidelines, Title 31, Part 10, Chapter 357 of the Texas Administrative Code, call for regional water planning groups to make recommendations regarding ecologically unique river and stream segments; unique sites for reservoir construction; and regulatory, administrative, or legislative actions that will facilitate the orderly development, management, and conservation of water resources. The Region C Water Planning Group established a subgroup that reviewed each of these topics and made recommendations to the entire planning group. Recommendations of the Region C Water Planning Group and the reasons for them are presented in this section in the following order:

- Summary of recommendations
- Recommendations for ecologically unique river and stream segments
- Recommendations for unique sites for reservoir construction
- Policy and legislative recommendations.

8.1 Summary of Recommendations

Recommendations for Ecologically Unique River and Stream Segments

- Convene a working group comprised of representatives of TWDB, TPWD, TCEQ, and the sixteen regions to bring clarity, purpose, and direction to the legislative mandate to "identify river and stream segments of unique ecological value[1]."

Recommendations for Unique Sites for Reservoir Construction

- Recommend that the Texas Legislature continue to designate the following sites as unique sites for reservoir construction:
    - Ralph Hall
    - Lower Bois d'Arc Creek
    - Marvin Nichols
    - Tehuacana
    - Fastrill
    - Columbia
- Recommend that the Texas Legislature designate George Parkhouse (North) as an additional unique site for reservoir construction
- Encourage continued affirmative votes by sponsors of these proposed reservoirs to make

expenditures necessary to construct or apply for required permits and avoid termination of unique reservoir site designations on September 1, 2015. Section 8.3 describes actions that sponsors have taken to preserve the unique reservoir site designations for these reservoirs.

Policy and Legislative Recommendations

- Senate Bill One Planning Process
  - Encourage formation of a Working Group on Stream Segments of Unique Ecological Value
  - Support legislative and state agency findings regarding water use evaluation
  - Allow waivers of plan amendments for entities with small strategies.
  - Coordination between TWDB and TCEQ to determine the appropriate data and tools for use in regional water planning and in permitting.
  - TWDB's recognition of Region C's designation of the Sulphur River Basin Authority as a wholesale water provider in the regional water planning process.
- TCEQ Policy and Water Rights
  - Legislature should remove some of the unnecessary barriers to interbasin transfers.
  - Support recent changes to water code that exempt certain water right permits from cancellation for non-use.
- State Funding and Water Supply Programs
  - Continue and expand State Funding for TWDB SWIFT, WIF, and other loans and programs State Participation Program.
  - Expand eligibility for SWIFT funding to include consistency with adopted regional water plans.
  - More State Funding for water conservation efforts.
  - State Funding for reservoir site acquisition.
  - Consider alternative financing arrangements for large projects.
  - Adequate funding of Groundwater Conservation Districts
  - Funding for NRCS structures as a form of watershed protection
- Water Reuse and Desalination
  - Support research to advance reuse and desalination
  - Funding assistance for desalination and water reuse projects.
- State and Federal Program – Water Supply Issues
  - Continued and increased State support for efforts to develop water supplies from Oklahoma.
  - Oversight of Groundwater Conservation District rule making.
  - Revise Federal Section 316(b) regulations on power plant cooling water.
  - Reallocation of storage in and maintenance of Federal reservoirs.

- Funding of long-range Federal water supply projects.

8.2 Recommendations for Ecologically Unique River and Stream Segments

Texas Parks and Wildlife Department (TPWD) recommendations for 10 ecologically unique river and stream segments in Region C were published in *Ecologically Significant River and Stream Segments of Region C, April 2002*. These 10 river and stream segments, along with the attributes that TPWD deemed qualifying for unique status, are listed in Table 8.1. The segments are also depicted in red in Figure 8.1. However, in previous Region C Water Plans, the Region C Water Planning Group decided not to recommend any river or stream segments as ecologically unique because of unresolved concerns regarding the implications of such a designation by the Texas Legislature. According to Texas Water Code 16.051(f), "This designation solely means that a state agency or political subdivision of the state may not finance the actual construction of a reservoir in a specific river or stream segment designated by the legislature…". However, the Texas Water Development Board regulations governing regional water planning require analysis of the impacts of water management strategies on unique stream segments, which implies a level of protection beyond the mere prevention of reservoir development.

In preparing for the *2011 Region C Water Plan*, the Region C Water Planning Group reviewed the 2006 recommendations of the other regional planning groups and directed its consultants to take the following actions with regard to ecologically unique river and stream segments:

- Develop scenarios of concern
- Meet with state agencies
- Review previously identified segments
- Consider additional segments
- Present possible candidate segments to the Region C Water Planning Group
- Receive comments
- Recommend action

The potential scenarios of concern involve the following features which could be located within, upstream, or downstream of a designated segment:

- Dams
- Pipeline crossings
- Water intakes
- New water outfalls
- Treated effluent outfalls

- Constructed wetlands
- Bed and banks transport of reservoir releases

These potential scenarios of concern were addressed by Region C consultants in a meeting with staffs of the Texas Water Development Board, Texas Parks and Wildlife Department, and Texas Commission on Environmental Quality (TCEQ) in August 2009. Ecologically unique river and stream segment legislation (Title 2, Chapter 16 of the Texas Water Code) and agency rules (Title 31, Part 10, Chapter 357 of the Texas Administrative Code) were also reviewed at the meeting. Conclusions from this meeting were as follows:

- TPWD plans no updates to its Ecologically Significant River and Stream Segments of Region C, April 2002. This report was summarized in Appendix W of the 2006 Region C Water Plan.
- TPWD and TWDB staffs believe that ecologically unique river and stream segment legislation only impacts public financing of reservoirs.
- TCEQ staff position is to use all available information to regulate attributes of river and stream segments without regard to ecologically unique designation.
- Ecologically unique river and stream segment designation may influence public opinion.
- Ecologically unique river and stream segment legislation has not been tested in the courts.
- A statewide TWDB/TPWD/TCEQ/RWPG working group could help address concerns.

The Region C Water Planning Group recommends the formation of a working group comprised of representatives of TWDB, TPWD, TCEQ, and the sixteen water planning regions to bring clarity, purpose, and direction to the legislative mandate to "identify river and stream segments of unique ecological value." Specifically, it is expected that the working group would:

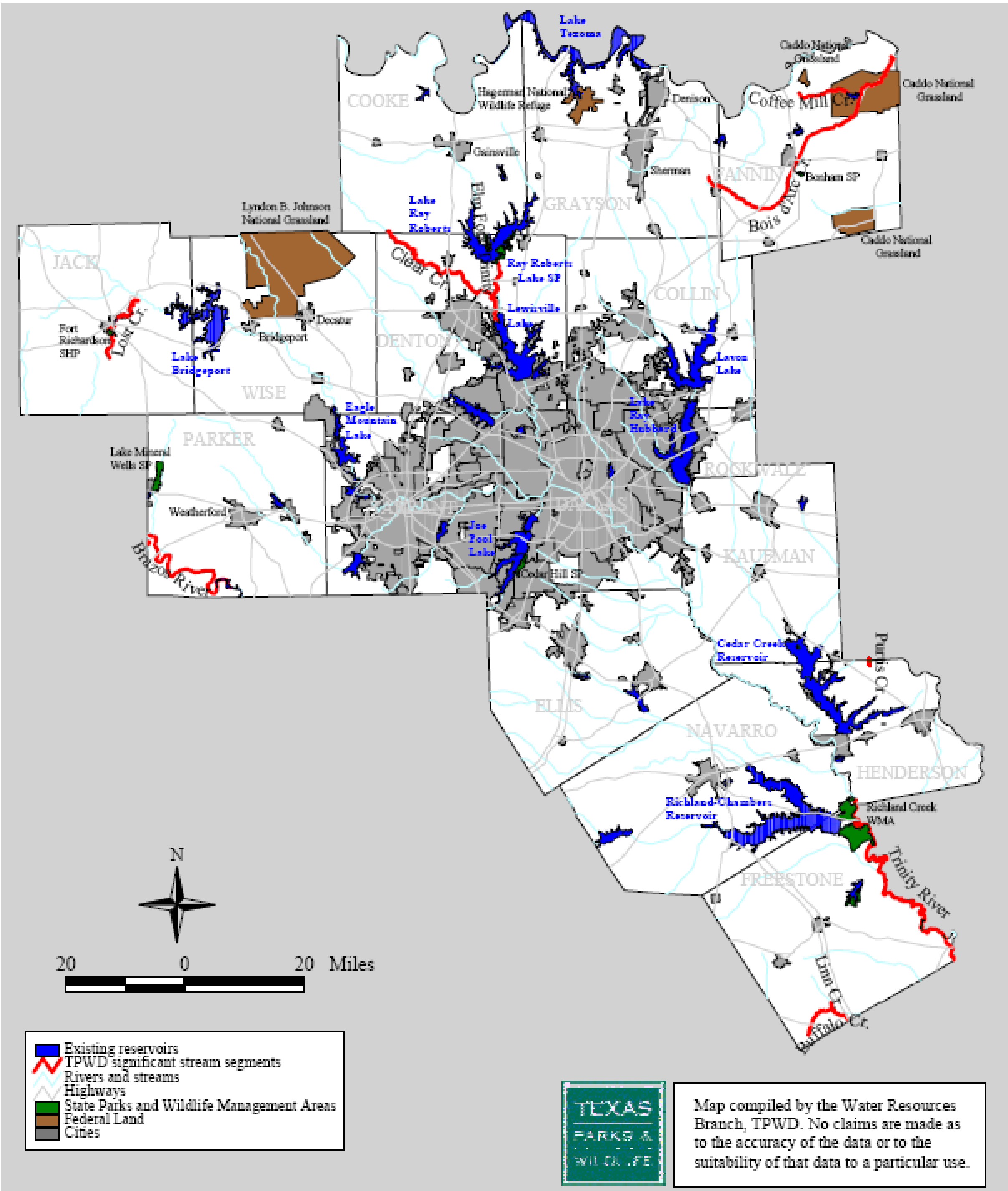
- Research, verify, and publicize the intent of ecologically unique river and stream segment legislation.
- Research agency rules and recommend changes or clarifications where needed.
- Ensure common understanding of "reservoir" as used in ecologically unique river and stream segment legislation and agency rules.
- Identify the lateral extent of ecologically unique river and stream segment designation.
- Seek clarification of quantitative assessment of impacts on ecologically unique river and stream segments.
- Illustrate the value of ecologically unique river and stream segment designations.

Table 8.1
Texas Parks and Wildlife Department Recommendations for Designation as Ecologically Unique River and Stream Segments [(2)]

Region C River or Stream Segment	Description	Basin	County	TPWD Reasons for Designation [a]				
				Biological Function	Hydro-logic Function	Riparian Conservation Area	High Water Quality/ Exceptional Aquatic Life/ Aesthetic Value	Endangered Species/ Unique Communities
Bois d'Arc Creek	Entire length	Red	Fannin/ Grayson	X	X	X		
Brazos River	F.M. 2580 to Parker/Palo Pinto County line	Brazos	Parker	X			X	X
Buffalo Creek	Alligator Creek. to S.H. 164	Trinity	Freestone	X	X			
Clear Creek	Elm Fork Trinity River to Denton/Cooke County line	Trinity	Denton				X	
Coffee Mill Creek	Entire length	Red	Fannin			X		
Elm Fork of Trinity River	Lewisville Lake to Lake Ray Roberts Dam	Trinity	Denton			X		
Linn Creek	Buffalo Creek. to C.R. 691	Trinity	Freestone	X	X			
Lost Creek	Entire length	Trinity	Jack			X	X	
Purtis Creek	S. Twin Creek. to Henderson/Van Zandt County line	Trinity	Henderson			X		
Trinity River	Freestone/Anderson/Leon County line to Henderson/Anderson County line	Trinity	Freestone/ Anderson	X		X		X

Note: a. The criteria listed are from Texas Administration Code, Title 31, Section 358.2. The Texas Parks and Wildlife Department feels that their recommended stream reaches meet those criteria marked with an X.

Figure 8.1
Texas Parks and Wildlife Department Recommendations for Designation as Ecologically Unique River and Stream Segments



8.3 Recommendations for Unique Sites for Reservoir Construction

In 2007, the 80th Texas Legislature passed Senate Bill 3, which designated unique sites for reservoir construction as recommended in the *2007 State Water Plan*, including the following sites previously recommended by the Region C Water Planning Group:

- Muenster site on Brushy Elm Creek in Cooke County
- Ralph Hall site on the North Sulphur River in Fannin County
- Lower Bois d'Arc Creek (formerly called New Bonham) site on Bois d'Arc Creek in Fannin County
- Marvin Nichols site on the Sulphur River in Red River, Titus, and Franklin counties
- Fastrill site on the Neches River in Anderson and Cherokee counties
- Tehuacana site on Tehuacana Creek in Freestone County.

SB3 also designated the Columbia site on Mud Creek in Cherokee County as a unique site for reservoir construction. This site was previously recommended by the East Texas Regional Water Planning Group.

These designations terminate on September 1, 2015, unless there is "an affirmative vote by a proposed project sponsor to make expenditures necessary in order to construct or file applications for permits required in connection with the construction of the reservoir under federal or state law."

Finally, a new reservoir located at the George Parkhouse (North) site is an alternative water management strategy in this *2016 Region C Water Plan* for the Upper Trinity Regional Water District (UTRWD) and the North Texas Municipal Water District (NTWMD).

With the exception of Muenster Lake, which has been constructed and is currently in operation, brief descriptions of each site follow, along with a summary of actions that the project sponsor has taken to bring the project to fruition.

Lake Ralph Hall would be located on the North Sulphur River in southeast Fannin County, north of Ladonia. The site is located in the Sulphur River Basin Region C. The reservoir would yield 34,050 acre-feet per year and would flood 7,605 acres. Lake Ralph Hall is a recommended water management strategy for the UTRWD. The proposed lake would provide water to southeast Fannin County residents, as well as to customers of the Upper Trinity Regional Water District in the Denton County area.

To develop Lake Ralph Hall, UTRWD has:

- Secured a water right. Permit 5821, issued in December 2013, allows UTRWD to impound up to 180,000 acre-feet in Lake Ralph Hall and to divert up to 45,000 acre-feet/year for municipal, industrial, irrigation, and recreation purposes. As part of the water right permitting process, UTRWD completed special engineering and cultural resources studies, including:

- Hydrologic and hydraulic studies,
  - Biological and in-stream flow assessment,
  - Geologic characteristics study,
  - Economic impact study, and
  - Water conservation implementation plan.
- Applied for a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers (USACE). As part of the 404 permitting process, UTRWD has completed special engineering and cultural resources studies, including:
  - Hydrologic and hydraulic studies,
  - Preliminary jurisdictional determination of waters of the U.S.,
  - Preliminary habitat assessment,
  - Archaeology & quaternary geology,
  - Biological and in-stream flow assessment,
  - Geologic characteristics,
  - Economic impact study,
  - Geomorphic and sedimentation evaluation, and
  - Draft mitigation plan for impacts to aquatic resources and terrestrial habitats.

Currently, UTRWD is working to complete a draft Environmental Impact Statement (EIS) for the proposed Lake Ralph Hall.

Lower Bois d'Arc Creek Reservoir would be located on Bois d'Arc Creek in Fannin County, immediately upstream from the Caddo National Grassland. The site is located in the Red river Basin Region C. The proposed reservoir would yield 123,000 acre-feet per year and would flood 16,400 acres. The North Texas Municipal Water District (NTMWD) would be the primary developer of Lower Bois d'Arc Creek Reservoir. The proposed reservoir is a recommended water management strategy to provide water to potential customers in Fannin County in addition to existing customers of the NTMWD.

To develop Lower Bois D'Arc Creek Reservoir, NTMWD has:

- Secured a water right. Permit 12151, issued in June 2015, allows NTMWD to impound up to 367,609 acre-feet in Lower Bois D'Arc Creek Reservoir and to divert up to 175,000 acre-feet/year for municipal, industrial, and irrigation purposes. As part of the water right permitting process, NTMWD has:
  - Contracted with conservation experts and enhanced its water conservation plan.
  - Reached settlement agreements with the National Wildlife Federation, the Sierra Club, Texas Parks and Wildlife Department, Bois D'Arc Municipal Utility District, and some landowners.

- Applied for a Clean Water Act Section 404 permit from USACE. As part of the 404 permitting process, NTMWD has:
  - Completed final pipeline alignment, intake pump station location, and terminal storage analysis study.
  - Completed archaeological study of reservoir site, pipeline route, and Leonard water treatment plant site and completed Phase 1 archaeological study of mitigation site.
  - Submitted a final proposed mitigation plan to USACE.
  - Completed 30 percent dam design and met with TCEQ to discuss the design.
  - Reviewed draft EIS and provided information as requested by USACE to assist in preparation of final EIS.
  - Purchased over 80 percent of the 22,590-acre area to be impacted by the reservoir.

Marvin Nichols Reservoir would be located on the Sulphur River upstream from its confluence with White Oak Creek. The dam would be in Titus and Red River counties and would also impound water in Franklin County. The site is located in the Sulphur River Basin in Region D.

The Region C entities that are interested in development of Marvin Nichols Reservoir and other Sulphur Basin Supplies (NTMWD, TRWD, Dallas, UTRWD, and Irving) have formed a Joint Committee on Program Development (JCPD). Since 2001, the JCPD has provided more than $5 million to the Sulphur River Basin Authority (SRBA) to further investigate the development of Marvin Nichols Reservoir and other potential water supply sources in the Sulphur River Basin. Ongoing Sulphur Basin Feasibility studies are being conducted by the U.S. Army Corps of Engineers, SRBA and the JCPD. At the direction of SRBA and the JCPD, these ongoing studies are seeking to address concerns from Region D entities regarding the protection of natural resources, environmental impacts, and the socio-economic impacts of developing water supply within Region D and the Sulphur Basin. As a result, these ongoing studies have identified additional options for water supply in the Sulphur Basin that may address concerns from Region D and would also develop supply needed for Region C and Region D entities.

As identified in the 2014 Sulphur River Basin studies [(4)], this 2016 Region C Water Plan recommends a Marvin Nichols Reservoir that would be part of a combined strategy with the reallocation of flood storage to conservation storage in Wright Patman Lake. (This combination is referred to in this plan as the Sulphur Basin Supplies strategy). The proposed combined Marvin Nichols and Wright Patman strategy would yield around 600,000 acre-feet per year (using TCEQ WAM models, assuming Lake Ralph Hall is senior and accounting for environmental flows). The Sulphur Basin Supplies strategy is a recommended water management strategy for NTMWD, UTRWD, and TRWD. It is also an alternative strategy for Dallas and the City of Irving. Approximately 80 percent of the water supplied from the

Sulphur Basin Supplies strategy is expected to serve customers of wholesale water providers in Region C and approximately 20 percent would serve water needs in Region D.

Region C recognizes that there are inherent risks and impacts associated with the reallocation of flood storage at Wright Patman Lake. Reallocation of storage at Wright Patman Lake at the scale envisioned for the Sulphur Basin Supplies strategy will require recommendation by the Corps of Engineers/Department of the Army and approval by the United States Congress. Prior to making a recommendation, the Corps will need to conduct a detailed evaluation of impacts associated with raising the conservation pool elevation. Potentially significant impacts could include inundation of natural resources within the flood pool, loss of flood protection downstream, increased impacts to cultural resources on the reservoir perimeter, effects on the Congressionally-established White Oak Creek Mitigation Area in the upper reaches of the Wright Patman flood pool, and reduced flexibility in International Paper's effluent management operations downstream of the dam. Wright Patman reallocation may also be constrained by Dam Safety considerations. As more detailed studies seek to develop an understanding of the tradeoffs between the environmental impacts at Wright Patman in comparison with the predicted impacts of new storage at the Marvin Nichols site, the risk exists that the Wright Patman reallocation alternative may be constrained by either policy or environmental issues, or both. Recognizing these risks and impacts of the reallocation of Wright Patman, Region C is retaining the original configuration of Marvin Nichols Reservoir (as detailed in the 2011 Region C Water Plan) as an alternative water management strategy for the 2016 Region C Water Plan. It is an alternative strategy for NTMWD, UTRWD, TRWD, and Irving.

As mentioned above, since 2001, the JCPD has provided more than $5 million to the Sulphur River Basin Authority (SRBA) to further investigate the development of Marvin Nichols Reservoir and other potential water supply sources in the Sulphur River Basin. These investigations have included:

- Land use/land cover classification
- Identification of reservoir sites and conservation pool elevations
- Reconnaissance geology review of potential dam sites
- Mapping
- A site selection study for Marvin Nichols Reservoir
- System operation assessment of Wright Patman Lake and Jim Chapman Lake
- Analysis of Sulphur River instream flows (hydrology, hydraulics, and fish habitat utilization)
- Aerial LIDAR survey

- Hydrologic and hydraulic modeling
- Modification of the TCEQ's Sulphur River Water Availability Model,
- Development of a Sulphur River Basin Soil and Water Assessment Tool (SWAT) model,
- Wright Patman Lake additional yield modeling,
- Socioeconomic Assessment,
- Comparative Environmental Assessment, and
- Studies of:
  - Operation issues,
  - Institutional issues, and
  - Water demand/availability.

These studies are needed to develop applications for a state water permit and a Section 404 permit for the project. Some of the investigations listed above are part of the recent Sulphur River Basin Feasibility Study, conducted by the JCPD in partnership with USACE and the SRBA (4). The combination of reallocation of water in Wright Patman Lake and development of Marvin Nichols Reservoir was the strategy recommended by the Feasibility Study.

Tehuacana Reservoir would be located on Tehuacana Creek in Freestone County, south of the Richland-Chambers Reservoir. The site is located in the Trinity River Basin in Region C. The proposed reservoir would yield 41,600 acre-feet per year and would flood 14,900 acres. Tarrant Regional Water District would be the developer of Tehuacana Reservoir. Tehuacana Reservoir is recommended water management strategy in the *2016 Region C Water plan* to serve needs in Freestone County in addition to customers of TRWD. Tehuacana Reservoir is also a recommended strategy in TRWD's Integrated Water Supply Plan (5). In addition, TRWD has completed an evaluation of four alternate dam locations and impact scenarios, reservoir site geology, natural resources, and land and mineral ownership (6).

Lake Columbia would be located on Mud Creek in Cherokee County, southeast of Jacksonville. The site is located in the Neches River Basin in Region I. The proposed reservoir would yield 85,507 acre-feet per year and would flood about 11,500 acres. The Angelina & Neches River Authority (ANRA) would be the developer of Lake Columbia, and purchasing water from Lake Columbia is a recommended water management strategy for Dallas. To develop Lake Columbia, ANRA has:

- Secured a water right. Permit 4228, issued in June 1985, allows ANRA to impound up to 195,500 acre-feet in Lake Columbia and to divert up to 85,507 acre-feet per year for municipal, industrial, and recreation purposes.
- Applied for a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers

(USACE).

- As part of the 404 permitting process, ANRA has:
  - Completed a downstream impact analysis.
  - Completed an archaeological field survey.
  - Completed a proposed mitigation plan.
  - Worked toward completion of a draft EIS.

Lake Fastrill would be located on the Neches River in Anderson and Cherokee counties downstream of Lake Palestine and upstream of the Weches dam site. The site is located in the Neches River Basin in Region I. The proposed reservoir would yield 148,780 acre-feet per year and flood 24,950 acres. In 2006, the U.S. Fish and Wildlife Service established the Neches River Wildlife Refuge along the Upper Neches River near the same area as the proposed Lake Fastrill. Lake Fastrill was formerly a recommended water management strategy for Dallas. On February 22, 2010, the U.S. Supreme Court declined to hear an appeal of a decision by the 5th Circuit Court of Appeals that ruled against construction of Fastrill Lake and in favor of the wildlife refuge. Since that decision, Dallas has replaced Lake Fastrill with other projects in its long-range water supply planning. However, the Upper Neches River Municipal Water Authority (UNRMWA) has continued to pursue development of Lake Fastrill, and this reservoir could be a potentially feasible water management strategy for Dallas beyond the planning period.

George Parkhouse Reservoir (North) would be located on the North Sulphur River in Lamar and Delta Counties, upstream of Marvin Nichols Reservoir and downstream of Lake Ralph Hall. The site is located in the Sulphur River Basin in Region D. The proposed reservoir would yield 148,700 acre-feet per year (with 118,960 acre-feet per year available for Region C), but the yield would be reduced substantially by development of Lake Ralph Hall and/or Marvin Nichols Reservoir. The proposed reservoir would flood 12,250 acres. George Parkhouse Reservoir (North) is an alternative water management strategy for UTRWD and NTWMD.

In partnership with the USACE and the SRBA, the JCPD (including UTRWD and NTWMD) has studied the proposed George Parkhouse Reservoir (North) as part of the Sulphur River Basin Feasibility Study. The reservoir yield and environmental impacts of the reservoir are documented in the Feasibility Study. These entities are continuing to study water supply options in the Sulphur River Basin, including George Parkhouse Reservoir (North).

Recommendations. The Region C Water Planning Group recommends that:

- The Texas Legislature continue to designate the following sites as unique sites for reservoir construction: Ralph Hall, Lower Bois d'Arc Creek, Marvin Nichols, Tehuacana, Columbia, and Fastrill.
- The Texas Legislature designate the George Parkhouse (North) site as a unique site for reservoir construction.
- Sponsors of these proposed reservoirs continue to affirmatively vote to make expenditures necessary to construct or apply for required permits for these reservoirs and avoid termination of unique reservoir site designation on September 1, 2015 (Section 16.051, Texas Water Code).

8.4 Policy and Legislative Recommendations

The Region C Water Planning Group discussed legislative and policy issues that impact the planning and development of water resources. The group offers the following policy and legislative recommendations, which are divided by topic.

Senate Bill One Planning Process

Encourage Formation of a Working Group on Stream Segments of Unique Ecological Value. The Region C Water Planning Group recommends the formation of a working group comprised of representatives of TWDB, TPWD, TCEQ, and the sixteen water planning regions to bring clarity, purpose, and direction to the legislative mandate to "identify river and stream segments of unique ecological value. " Specifically, it is expected that the working group would:

- Research, verify, and publicize the intent of ecologically unique river and stream segment legislation.
- Research agency rules and recommend changes or clarifications where needed.
- Ensure common understanding of "reservoir" as used in ecologically unique river and stream segment legislation and agency rules.
- Identify the lateral extent of ecologically unique river and stream segment designations.
- Seek clarification of quantitative assessment of impacts on ecologically unique river and stream segments.
- Illustrate the value of ecologically unique river and stream segment designations.

Support Legislative and State Agency Findings Regarding Water Use Evaluation. Per capita water use is unique to each water supplier and each region of the State. A statewide per capita water use value is not appropriate for the State, considering its wide variation in rainfall, economic development, and other factors.

Since the *2011 Region C Water Plan*, the Texas Legislature found that:

- "…using a single gallons per capita per day metric to compare the water use of municipalities and water utilities does not produce a reliable comparison because water use is dependent on several variables, including differences in the amount of water used for commercial and industrial sector activities, power production, permanent versus temporary service populations, and agricultural sector production…" and

- "a sector-based water use metric, adjusted for variables in water use by municipalities and water utilities, is necessary in order to provide an accurate comparison of water use and water conservation among municipalities and water utilities [7]."

Similarly, in its *Guidance and Methodology for Reporting on Water Conservation and Water Use*, the TCEQ/TWDB/WCAC recognized that "a simple comparison of total gallons per capita per day among Texas municipal water providers may lead to inaccurate conclusions about comparative water use efficiencies among those municipal water providers. When examining the profiles of municipal water providers individually, significant differences may be found in climate, geography, source water characteristics, and service population profiles. As a metric, total gallons per capita per day has its limitations [8]." The Guidance further recommends use of sector-specific metrics in tracking and comparing water conservation and water.

The Region C Water Planning Group supports these findings and encourages continued development and refinement of sector-specific metrics for tracking water use.

Allow Waivers of Plan Amendments for Entities with Small Strategies. Region C recommends that the Texas Water Development Board allow waivers for consistency issues for plan amendments that involve projects resulting in small amounts of additional supply.

Coordination between TWDB and TCEQ Regarding Use of the WAMs for Planning and Permitting. The TWDB requires that the Water Availability Models (WAMs) developed under the direction of TCEQ be used in determining available surface water supplies. The models were developed for the purpose of evaluating new water rights permit applications and are not appropriate for water supply planning. The assumptions built into the WAM (full use of all existing water rights, full operation of priority calls at all times, full permitted area and capacity, overlapping of environmental flow criteria developed during the Senate Bill 3 process and special conditions for instream flows developed using other statistical approaches) do not match the actual operations of supplies and could prohibit the issuance of water rights permits upon which implementation of the regional plans is dependent. Using these conservative assumptions could result in unnecessary water supply projects to meet projected needs that might otherwise be satisfied through the flexible permitting of existing supplies. The TWDB and TCEQ should coordinate their efforts to determine the appropriate data and tools available through the WAM program for use in water planning and permitting. The TWDB should allow the regional water planning groups flexibility in applying the models made available for planning purposes and should exercise flexibility in permitting to allow for optimization of existing or future water supplies.

TWDB's recognition of Region C's designation of the Sulphur River Basin Authority as a Wholesale Water Provider in the Regional Water Planning Process. According to 31 TAC §357.10(3), a wholesale water provider is:

> "Any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan. The regional water planning groups shall include as wholesale water providers other persons and entities that enter or that the regional water planning group expects or recommends to enter contracts to sell more than 1,000 acre-feet of water wholesale during the period covered by the plan."

As described in previous sections, the Sulphur Basin Supply strategy is a recommended water management strategy for NTMWD, UTRWD, and TRWD and an alternative strategy for Dallas and the City of Irving. It is expected that SRBA would permit and construct Marvin Nichols Reservoir in the Sulphur Basin and would sell more than 1,000 acre-feet per year of water from the reservoir to these Region C entities. For these reasons, the RCWPG voted to designate SRBA as a WWP at its September 28, 2015 meeting. RCWPG requests TWDB's recognition of this designation in the regional water planning process.

TCEQ Policy and Water Rights

Requirements for Interbasin Transfers Introduced in Senate Bill One. In 1997, Senate Bill One introduced a number of new requirements for applications for water rights permits to allow interbasin transfers. The requirements are found in Section 11.085 of the Texas Water Code [9]. The code includes many provisions that are not required of any other water rights, including:

- Public meetings in the basin of origin and the receiving basin.
- Simultaneous (and dual) notices of an interbasin transfer application in newspapers published in every county located either wholly or partially in both the basin or origin and the receiving basin, without regard to the distance or physical relationship between the proposed interbasin transfer and any such county's boundaries.
- Additional notice to county judges, mayors, and groundwater districts in the basin of origin.
- Additional notice to legislators in the basin of origin and the receiving basin.
- TCEQ request for comments from each county judge in the basin of origin.
- Proposed mitigation to the basin of origin.
- Demonstration that the applicant has prepared plans that will result in the "highest practicable

water conservation and efficiency achievable…".

Exceptions to these extra requirements placed on interbasin transfers are made for emergency transfers, small transfers (less than 3,000 acre-feet under one water right), transfers to an adjoining coastal basin, transfers to a county partially within the basin of origin, transfers within a retail service area, and certain imports of water from outside the state.

The effect of these changes is to make obtaining a permit for interbasin transfer significantly more difficult than it was under prior law and thus to discourage the use of interbasin transfers for water supply. This is undesirable for several reasons:

- Interbasin transfers have been used extensively in Texas and are an important part of the state's current water supply. For example, current permits allow interbasin transfers of over 896,000 acre-feet per year from the Red, Sulphur, Sabine, and Neches Basins to meet needs in the Trinity Basin in Region C. This represents more than one-third of the region's reliable water supply.
- Current supplies greatly exceed projected demands in some basins of origin, and the supplies already developed in those basins can only be beneficially used as a result of interbasin transfers.
- Senate Bill One water supply plans for major metropolitan areas in Texas (Dallas-Fort Worth, Houston, and San Antonio) rely on interbasin transfers as a key component of their plans.
- Texas water law regards surface water as "state water" belonging to the people of the state, to be used for the benefit of the state as a whole and not merely that area or region of the state where abundant surface water supplies may exist [(10)].
- The current requirements for permitting interbasin transfers provide unnecessary barriers to the development of the best, most economical, and most environmentally acceptable source of water supplies.

The legislature should revisit the current law on interbasin transfers and remove some of the unnecessary, unduly burdensome, and counterproductive barriers to such transfers that now exist.

Cancellation of Water Rights for Non-Use. Texas Water Code [(11)] allows the Texas Commission on Environmental Quality to cancel certain water rights, in whole or in part, for ten consecutive years of non-use. Since the *2011 Region C Water Plan*, the Texas Legislature provided the following additional exceptions to cancellation for non-use:

- If a significant portion of the water authorized has been used in accordance with a specific recommendation for meeting a water need included in an approved regional water plan;
- If the water right was obtained to meet demonstrated long-term public water supply or electric generation needs as evidenced by a water management plan developed by the holder and is consistent with projections of future water needs contained in the state water plan; or
- If the water right was obtained as the result of the construction of a reservoir funded, in whole or in part, by the holder of the water right as part of the holder's long-term water planning.

These changes assist with long-term water supply planning and allow construction of reservoirs to meet future needs, even if only part of the supply is used in the first ten years of the reservoir's operation, Region C supports these exceptions to cancellation of water rights for non-use.

State Funding for Water Supply Programs

Continued and Expanded State Funding for Texas Water Development Board Loans and the State Participation Program. The total capital cost of strategies recommended in the 2012 State Water Plan is $53 billion, including $21.5 billion for Region C recommended strategies. Municipal water providers anticipate needing $26.9 billion from state financial assistance programs, including $11.7 billion in Region C [(12)]. The Texas Water Development Board's loan and State Participation Programs have been important tools in the development of existing supplies, but funding for many of these programs has been insufficient to serve all applicants. The new SWIFT/SWIRFT funding program, described in Chapter 5, is expected to leverage its initial $2 billion funding to finance close to $27 billion of recommended water management strategies over the next 50 years [(13)]. Twenty percent of the SWIFT funding is reserved for water conservation and reuse projects.

These programs should be continued and expanded with additional funding as needed to assist in the development of the water management strategies recommended in the regional water plans to meet the future water needs in Texas. Region C supports the continued expeditious implementation of the SWIFT/SWIRFT funding program and does not support diversion of existing funding for other purposes.

Expand Eligibility for SWIFT Funding to Include Consistency with Adopted Regional Water Plans. The current legislation specifies that a water supply project must be in the adopted State Water Plan to be eligible for SWIFT funding. To allow the TWDB sufficient time to develop the State Water Plan, there is a one-year period between when a regional water plan is adopted and when the TWDB approves the corresponding State Water Plan. During this one-year period, the State Water Plan is based on recommended projects in a superseded regional water plan. Under current law, if a project is included in the current regional water plan but not in the superseded regional water plan, the project sponsor must amend the superseded regional water plan to receive SWIFT funding. This could mean that the regions and project sponsors are expending funds for a process that has already been completed for the current regional water plan. It is recommended that the consistency requirement with the State Water Plan for eligibility for SWIFT funds be expanded to include the currently adopted regional water plans.

State Funding for Water Conservation Efforts. In 2007, the Texas Legislature formed the Water Conservation Advisory Council to serve as an expert resource to the state government and the public on water conservation in Texas. The Council publishes biennial reports to the Legislature on progress of water conservation in Texas. In its December 2014 report, the Council identified "an immediate need for water conservation awareness and heightened messaging on a statewide level. An expansion of the capabilities and reach of the state's existing water conservation public awareness program, Water IQ, would increase the state-wide messaging of water conservation and public awareness of the importance of water conservation [14]."

Region C encourages adequate funding for the Water Conservation Advisory Council and for a statewide water conservation awareness campaign.

State Funding for Reservoir Site Acquisition. As described in Section 8.3, the State of Texas has designated unique sites for reservoir development. . However, the designation of these sites does not fully protect them for development as reservoirs. For example, in 2006 the U.S. Fish and Wildlife Service established the Neches River Wildlife Refuge along the Upper Neches River near the same area as the proposed Lake Fastrill, which may forestall development of the reservoir.

Region C recommends that TWDB and the Legislature consider assisting with the acquisition of sites to achieve a greater degree of protection for development of the sites as reservoirs. Actions that could be taken include:

- The use of state funds to acquire reservoir sites.
- Changing TWDB regulations so that Water Infrastructure Fund resources can be used for the acquisition of reservoir sites before completion of the permitting process.
- Encouraging voluntary sales of land in these reservoir sites to entities planning to develop the reservoirs.

Consider Alternative Financing Arrangements for Large Projects. The Texas Water Development Board offers low-interest financing for development of projects from the State Water Plan through the Water Infrastructure Fund. TWDB also offers deferred financing with delayed requirements for repayment, but the terms for deferred financing are not as flexible as they might be.

To address this issue, the TWDB has created two flexible financing options in the new SWIFT/SWIRFT funding program:

- Deferred loans have maturities of 20 to 30 years and may be used to fund developmental costs, such as planning and design. Principal and interest are deferred up to eight years or until end of construction, whichever is sooner.
- Board participation loans allow entities to reasonably finance the total debt for an optimally sized regional facility through temporary TWDB ownership interest in the facility. The local

sponsor repurchases TWDB's interest on a repayment schedule that defers principal and interest. The typical maturity of a Board participation loan is 34 years.

Region C supports the flexible financing options offered under the SWIFT/SWIRFT funding program and encourages the Texas Water Development Board and the Legislature to continue to consider more flexible deferred financing.

Adequate Funding of Groundwater Conservation Districts. In recent years, the Texas Legislature has created a great number of new groundwater conservation districts across the state. Especially in the early years of their existence, many of these districts struggle to find adequate resources to develop and implement their rules. We recommend that the state fund a grant program to provide financial resources for the development of the initial rules of these districts.

Funding for NRCS Structures as a Form of Watershed Protection. One key element of water supply planning is the protection of the quality and usability of supplies already developed. Over the past 50 to 60 years, the U.S. Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) has built numerous small dams for sediment control and flood control in Texas. The NRCS reservoirs improve water quality, prevent erosion in the watershed, provide water for livestock and provide increased streamflows during low flow periods.

The design life for the majority of the NRCS dams is 50 years. Most of the existing projects were built in the 1950s and 1960s and are nearing the end of their design life. Many NRCS structures are in need of maintenance or repair in order to extend their useful life. Under the PL-566[a] program, the NRCS provides technical assistance and funding for repair and rehabilitation of existing NRCS structures. The rehab program is a 65/35 split of federal funds to the sponsor's funds. In U.S. Congressional Districts located completely or partially within Region C, there are 1,086 existing NRCS dams, of which about 66 percent are located in Region C [(15)]. In these Congressional Districts, there are 120 dams in need of repairs and 129 dams in need of rehabilitation. The estimated repair and rehabilitation costs for these dams are approximately $36.2 million and $191.5 million, respectively. Currently, in the Region C area, rehabilitation of five NRCS structures is being planned, designed or constructed with funding through

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[a]PL-566, the Watershed Protection and Flood Prevention Act of 1954, provides for cooperation between the Federal government and the States and their political subdivisions in a program to prevent erosion, floodwater, and sediment damage; to further the conservation, development, utilization, and disposal of water; and to further the conservation and proper utilization of land in authorized watersheds.

the NRCS [16]. In addition, the NRCS and local sponsors plan to construct new dams in Region C. Under the PL-566 program and the similar PL-534[b] program, the NRCS will provide 100 percent of the construction costs of new dams, and the sponsor provides the land acquisition costs. There are active work plans in seven watersheds located completely or partially in Region C. In these seven watersheds, 117 new dams are planned, with an unfunded Federal commitment of more $159 million as of fiscal year 2012 [17, 18]. Some of these projects are ready to construct, but the funding is not currently available.

The State should develop a program to provide funding for the development and rehabilitation of new and existing NRCS structures, as a form of watershed protection. Elements of such a program could include:

- State grants or matching funding for studies of NRCS structures
- Seminars on watershed protection.

The Region C Water Planning Group recommends that the State seek additional federal funding to improve and maintain NRCS structures. Region C also recommends that the State provide funding to local sponsors to aid them in paying for their required 35 percent of the cost for the dam rehabilitation projects.

Water Reuse and Desalination

Support for Research to Advance Reuse and Desalination. Water reuse and desalination are becoming increasingly important sources of water supply for Texas. We recommend that the Legislature and the TWDB continue to support research to advance these emerging water supply strategies in the coming years.

Funding Assistance for Desalination Projects. The Red River and Lake Texoma in Region C have high concentrations of salts. The water from these sources must either be blended with a less saline supply or desalinated for direct use. The smaller communities neighboring these water supplies could potentially use this water with help in funding the necessary desalination process. These sources would be more economical for the smaller communities than building small pipeline of great lengths to

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[b]PL-534, the Flood Control Act of 1944, authorizes the Secretary of Agriculture to install watershed improvement measures in 11 watersheds, also known as pilot watersheds, to reduce flood, sedimentation, and erosion damage; improve the conservation, development, utilization, and disposal of water; and advance the conservation and proper utilization of land.

purchase water from a larger supplier. Region C recommends that the TWDB provide funding assistance for desalination projects for smaller communities. Region C also recommends that federal funds be sought for desalination projects.

Funding Assistance for Water Reuse Projects. The Region C Water Plan includes reuse as a key water management strategy to meet the water needs of the Region between now and 2070. Water reuse projects are rapidly developing in Region C. In the *2011 Region C Water Plan*, the 2060 supply from existing reuse projects was slightly over 336,000 acre-feet per year (19). In the current plan, newly developed projects have increased the supply available from existing reuse projects to more than 391,000 acre-feet per year by 2070. The current plan also calls for development of an additional 233,000 acre-feet per year in reuse projects by 2070. Statewide, 14 of the 16 regions included reuse as a water management strategy in their most recent water plans (9). In order to achieve implementation of the significant quantities of reuse there is a critical need to develop implementation approaches, funding support, and the technology and science associated with reuse. The Texas Water Development Board developed a research agenda that identified 7 research priorities in Texas (20):

- Understanding the role of environmental buffers in surface water indirect potable reuse projects
- Effectiveness of treatment wetlands in improving reclaimed water quality
- Use of managed aquifer recharge systems to facilitate water reclamation in Texas
- Understanding the effectiveness of nutrient removal processes in reduction of constituents of concern relative to indirect potable reuse
- Understanding the potential for utilizing nanofiltration as a beneficial treatment process relative to reclaimed water in Texas
- Organizational, institutional, and public awareness framework to advance water reuse in Texas
- Development of integrated water quality models for the Trinity River System

Region C recommends that the State Legislature to provide funding support to perform research in the priority categories identified by the Texas Water Development Board.

State and Federal Programs – Water Supply Issues

Continued and Increased State Support of Efforts to Develop Water Supplies for Oklahoma. In recent years, water suppliers in Region C have been seeking to develop unused water resources in Oklahoma. We encourage the State of Texas to continue and increase its support of efforts to develop unused water resources in Oklahoma.

Oversight of Groundwater Conservation District Rule Making. The Legislature has established groundwater conservation districts across Texas, often without regard for aquifer boundaries. These groundwater conservation districts develop rules and regulations regarding groundwater pumping within their boundaries. Often, the rules that have been developed by these districts are inconsistent from one district to the next, resulting in inconsistent regulation of the same aquifer. Although one-size-fits all regulations are inappropriate, the groundwater conservation districts need state oversight, particularly with regard to their rule-making policies. Region C recommends that the TWDB or TCEQ provide oversight for the current and future groundwater conservation districts.

Revise Federal Section 316(b) Regulations on Power Plant Cooling Water. Recent USEPA regulations implementing Section 316(b) of the Clean Water Act place requirements on cooling water intake structures that are intended to reduce fish/shellfish mortality due to impingement on screens/barriers or entrainment into flow entering an industrial facility. Although the regulations do not mandate cooling towers for new or existing power plants, they do generally require equivalent performance in terms of intake flowrates and velocities. Compared to once-through cooling (which was the usual approach in Texas prior to the new regulations), cooling towers reduce the amount of water diverted for a power plant but significantly increase the amount of water consumed. There is also a secondary impact; operation of cooling towers creates a high TDS (total dissolved solids) waste stream known as blowdown, that must managed and/or treated, often resulting in additional increased water consumption. This higher water consumption is not good for Texas, where water supplies are scarce. We encourage TWDB and TCEQ to work with the Federal government on Section 316(b) regulations to allow the efficient use and conservation of water supplies for power plants and the state.

CHAPTER 8
LIST OF REFERENCES

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9 Infrastructure Funding Recommendations

This plan has identified $23.6 billion in improvements needed by 2070 to meet the projected water demands in Region C. An infrastructure financing survey was conducted as part of the regional water planning process to better assess the state's role in financing the identified water projects. TWDB funding programs that may be sources of funding for projects in the regional water plans are discussed in Section 9.2 of this plan.

For this planning cycle, the TWDB developed the infrastructure financing survey to evaluate the amount of state funding that water users are likely to request. Using the results of this survey, this chapter identifies the portion of capital improvements recommended for Region C that may require TWDB financial assistance and identifies the potential TWDB financial categories that will be used. The survey developed by the TWDB included the following three financial categories:

- Planning, Design, Permitting & Acquisition Funding
- Construction Funding
- State Participation Funding.

It should be noted that the capital costs contained in the surveys were from the Initially Prepared Plan (IPP) published in May 2015. Between the IPP and this Final Plan some cost estimates were updated, resulting in a total capital cost of strategies in this final plan that is slightly different than the total capital cost of strategies surveyed.

9.1 Infrastructure Financing Questionnaires for Recommended Water Management Strategies

The infrastructure financing surveys were sent by post office in July 2015 to all municipal water user groups (WUGs) and wholesale water providers (WWPs) in Region C that had water management strategies with capital costs. Surveys were not sent to entities that had no capital cost strategies in the plan or to split-region-WUGs that are located primarily in other regions. An attempt was made to survey as many as possible of the aggregated WUGs that had capital cost strategies in the plan. These aggregated WUGs included the county-other WUGs and the non-municipal WUGs for each county (manufacturing, mining, steam electric power, irrigation, and livestock). These surveys were sent to either the county judge or to the water supplier that was providing water through the strategy.

A total of 286 surveys were mailed - 249 to water user groups, 37 to wholesale water providers. Many of the proposed capital improvements recommended in this plan involve one or more of the wholesale water providers. As a result, more than 95 percent of the total Region C plan costs are borne by the wholesale water providers - and over 89 percent is borne by the 11 regional wholesale water providers.

Water User Groups (WUGs)

Of the 249 water user groups surveyed, 48 submitted responses, resulting in an overall 19 percent participation rate in this survey. This is a lower response rate than desired. These 48 responders account for 28 percent of the total capital costs identified by all of the WUGs. Appendix R includes a sample copy of the survey, along with a summary of the survey responses. To help encourage additional input, the Region C Water Planning Group attempted to contact some entities who had the highest capitol cost and whose survey response had not been received.

Thirty-seven of the responding water user groups (79 percent) plan to finance 100 percent of the capital costs for improvements identified in the survey without TWDB assistance. The remaining respondents reported being able to pay for a portion of the estimated capital improvements, but would likely apply for one, or more, TWDB funding programs. Summaries of the water user group responses are included in Appendix R. A summary of the survey results for the water user groups is presented in Table 9.1.

Wholesale Water Providers (WWPs)

Fifteen wholesale water providers responded to the financing surveys, resulting in a 41 percent response rate. These 15 responders account for 94 percent of the total capital costs for all WWPs. Four WWPs responded that they intend to secure their own financing for 100 percent of the identified capital improvements, although some stated that they might consider using state funding in the future. The other 11 reported that it is likely they can secure their own financing for a portion of the total capital improvements, but that TWDB funding would also be required.

Summaries of the wholesale water provider responses are included in Appendix R. Table 9.1 provides the financing needs for the wholesale water providers based on the survey results.

Summary

Overall, the TWDB IFR survey received a 22 percent response rate (19 percent of WUGs and 41 percent of WWPs). However, on a monetary basis, the survey respondents accounted for 91 percent of the total capital costs in Region C (28 percent of WUG costs and 94 percent of WWP costs). Based on the survey responses, from both WUGs and WWPs, the water users in Region C are likely to request financial assistance from the TWDB to pay for approximately $15.0 billion (67 percent) of the capital costs identified for those entities' water supply infrastructure.

Table 9.1
Summary of Financing Needs in Region C[1]

	Water User Groups	Wholesale Water Providers	TOTAL
Total Costs of Strategies — All Entities Surveyed	**$1,091,004,000**	**$21,130,605,000**	**$22,221,609,000**
Total Costs of Strategies - IFR Responses	**$310,605,000**	**$19,887,021,000**	**$20,197,626,000**
Amount Likely to be Funded by Planning, Design, Permitting & Acquisitions Funding	$4,891,000	$1,520,809,000	$1,525,700,000
Amount Likely to be Funded by Construction Funding	$130,836,000	$13,369,337,000	$13,500,173,000
Amount from Entities Indicating "Not Applicable" to Project Costs or "Project Completed"[2]	$1,806,000	$76,000,000	$77,806,000
Remaining Costs[3]	$953,471,000	$6,164,459,000	$7,117,930,000
Amount Respondents Requested from TWDB Programs	**$135,727,000**	**$14,890,146,000**	**$15,025,873,000**
Total Costs of Strategies—Entities Not Responding to IFR Survey	$780,399,000	$1,243,584,000	**$2,023,983,000**

1. The summary of costs reported in this table reflect survey responses submitted to Region C as of November 9, 2015. The total costs of strategies in this table was as of the date of the Initially Prepared Plan (IPP). Updates to some cost estimates were made between IPP and this final plan so the total cost of projects surveyed is slightly different from the total cost of projects now listed in this final plan.
2. One WUG responded that the project listed in the survey had been completed. One WWP responded that they have already received SWIFT funding in this amount for this project.
3. The remaining costs likely would be funded either by cash reserves, bonds, loans, or other programs.

9.2 TWDB Funding Mechanisms

To help implement water management strategies, there are numerous funding programs available through Texas Water Development Board (TWDB). Table 9.2 shows the potential TWDB funding sources. The primary means of funding for projects in the regional and state water plan is expected to be TWDB's new SWIFT program (State Water Implementation Fund for Texas). In the 83rd Regular Session, the Texas Legislature (2013), via the passage of House Bill 4, outlined the structure and administration of SWIFT, including a prioritization process for projects and the creation of a legislative advisory committee. SWIFT supports low-cost financing of water projects in the State Water Plan through the issuance of bonds with subsidized interest rates, longer repayment terms, incremental repayment terms, and deferral periods. The TWDB will solicit abridged applications for SWIFT assistance up to twice a year. The abridged applications will then be prioritized for funding consideration. The TWDB anticipates selling bonds for each round of funding through the SWIFT. More detail on SWIFT can be found in Section 5E.3.2 of this report.

Table 9.2
Summary of Texas Water Development Board Funding Programs

Program	Type	Eligible Water Supply Projects
State Water Implementation Fund for Texas	Loans	Projects in the state water plan.
Drinking Water State Revolving Fund	Loans	Water supply and source water protection
Water Development Fund Program	Loans	Planning, acquisition and construction of water related infrastructure
Clean Water State Revolving Fund Program	Loans	Wastewater recycling and reuse facilities
State Participation Program	Loans	Regional water, wastewater recycling and reuse facilities
Agriculture Water Conservation Loan	Loans	Install efficient irrigation equipment on private property
Water Infrastructure Fund	Loans	Water management strategies recommended in state or regional water plans
Rural Water Assistance Fund	Loans	Development or regionalization of rural water supplies
Economically Distressed Area Program	Grants, Loans	Water and sewer service to economically distressed areas
Regional Facility Planning Grant Program	Grant	Studies and analyses of regional water supply and wastewater facility needs

10 Plan Approval Process and Public Participation

This section describes the plan approval process for the Region C Water Plan and the efforts made to inform the public and encourage public participation in the planning process. Special efforts were made to inform the general public, water suppliers, and others with special interest in the regional water plan and to seek their input.

10.1 Regional Water Planning Group

The legislation for Senate Bill One and the Texas Water Development Board (TWDB) planning guidelines establish regional water planning groups to control the planning process [1]. Each regional water planning group includes representatives of twelve designated interest groups:

- General public
- Counties
- Municipalities
- Industrial
- Agricultural
- Environmental
- Small businesses
- Electric generating utilities
- River authorities
- Water districts
- Water utilities
- Groundwater Management Areas (GMAs)

Table 10.1 lists the members of the Region C Water Planning Group as of March 2015 and the interests they represent. For most of the fourth round of planning, Jim Parks was the Chair of the Region C Water Planning Group, Jody Puckett was Vice-Chair, and Russell Laughlin was Secretary. A number of planning group members did not seek reelection to the Region C Water Planning Group as their terms expired during this planning cycle. They were Bill Lewis, Paul Phillips and Mary Vogelson. Members elected to fill their respective positons were Steve Mundt, James Hotopp, and Thomas LaPoint. Several members resigned during the planning cycle. They were Jim Parks, Jerry Chapman, Danny Vance, Steve Berry, Frank Crumb, and Thomas LaPoint. Members elected to fill their respective positions were Tom Kula, Drew Satterwhite, Kevin Ward, Bob Riley, John Carman, and John Lingenfelder.

Table 10.1
Current Members of the Region C Water Planning Group (March 2015)

Member	Interest
Jody Puckett, Chairman	Municipalities
Russell Laughlin, Vice Chair	Industry
Kevin Ward, Secretary	River Authorities
David Bailey	Groundwater Management Areas (GMA12)
John Carman	Municipalities
Bill Ceverha	Public
Gary Douglas	Groundwater Management Areas (GMA11)
James Hotopp	Municipalities
Tom Kula	Water Districts
Harold Latham	Groundwater Management Areas (GMA8)
John Lingenfelder	Public
G.K. Maenius	Counties
Howard Martin	Municipalities
Jim McCarter	Water Utilities
Steve Mundt	Small Business
Bob Riley	Environment
Drew Satterwhite	Water Districts
Bob Scott	Environment
Gary Spicer	Electric Generating Utilities
Connie Standridge	Water Utilities
Jack Stevens	Water Districts
Dr. Tom Woodward	Agriculture

10.2 Outreach to Water Suppliers, Water User Groups, and Regional Planning Groups

The Region C Water Planning Group made special efforts to contact water suppliers and water user groups in the region and neighboring regional water planning groups to obtain their input in the planning process. Water suppliers and water user groups were surveyed and contacted on a number of occasions to solicit information on their current situation and their future water plans. Region C coordinated with Regions D, G, H, and I regarding shared resources and water user groups that were located in multiple regions.

Five of the largest wholesale water providers in the region (Dallas Water Utilities, Tarrant Regional Water District, North Texas Municipal Water District, Fort Worth, and Trinity River Authority) were represented on the water planning group. In addition, the planning group encouraged the Region C consultants to keep in touch with wholesale water providers and other water suppliers as planning proceeded. Water suppliers were included on the mailing list for Region C newsletters (discussed below under outreach to the public). Other specific measures to obtain input from water suppliers and from other regional water planning groups are discussed below.

Questionnaires

A number of questionnaires have been sent to the Region C water user groups and wholesale water providers. Appendix D includes copies of the questionnaires that were mailed in early 2013 to all Region C cities with populations over 500 and retail water suppliers (supplying over 0.25 mgd) located in Region C. The questionnaires sought information on population and demand projections, current water supplies, future water management strategies, conservation, and other water planning issues. Following the deadline for this questionnaire, the consultants called each entity whose survey response had not been received. The follow-up phone calls resulted in increased participation rate and additional information acquired. The overall response rate for the population and water planning issues questionnaire was 55 percent.

Another questionnaire was sent to all water user groups and wholesale water providers via email prior to the publication of Region C's Initially Prepared Plan (IPP). This questionnaire asked for either agreement or further input on the entities' recommended water management strategies.

Lastly, a questionnaire was mailed to water user groups and wholesale water providers after the publication of the IPP. This questionnaire was developed by TWDB and sought input regarding how much, if any, TWDB funding each entity will likely pursue to develop the strategies outlined in this plan and when that funding would be needed. The results of this survey are compiled and discussed in Chapter 9 and in Appendix R of this report.

Meetings with Wholesale Water Providers and Other Suppliers

The consultants met in person with many of the wholesale water providers and with water user groups that were interested in meeting. The consultants spoke with wholesale water providers by phone when the provider thought that an in-person meeting was not necessary.

During the planning process, the consultants met with or held conference calls with the following water suppliers on one or more occasions. Discussion topics included current water supplies, current customers, population and demand projections, recommendations in the 2011 Plan, future water supplies, water treatment plant capacity and planned expansions, and additional wholesale customers. The consultants held meetings (unless noted, the meeting was in-person) with the following water suppliers:

- Arlington
- Athens MWA and City of Athens (teleconference)
- Corsicana
- Dallas County Park Cities Municipal Utility District (teleconference)
- Dallas Water Utilities
- Denton
- Fort Worth
- Grand Prairie
- Greater Texoma Utility Authority
- Irving
- North Texas Municipal Water District
- Rockett SUD
- Sabine River Authority (teleconference)
- Tarrant Regional Water District
- Trinity River Authority
- Upper Neches River Municipal Water Authority (teleconference)
- Upper Trinity Regional Water District
- Walnut Creek SUD
- Waxahachie
- Weatherford
- Wise County Water Supply District (teleconference)

The meetings with the providers listed above provided a better understanding of the current water supplies and the manner in which they are used, the current customers, current infrastructure limitations, potential future customers, and planned water supply and infrastructure improvement projects. These meetings were useful in determining recommended strategies for the Region C Water Plan.

10.3 Outreach to the Public

Newsletters

The Region C Water Planning Group published newsletters throughout this fourth round of the Regional Water Planning process to keep the public informed on the progress of the planning process, as well as to educate the public about water management strategies under consideration, water conservation issues and other water-related topics. The newsletters were sent to:

- Water User Groups
- Wholesale Water Providers

- Other water right holders
- County judges
- Mayors and officials of cities in the region
- Other water planning regions
- Texas Water Development Board staff
- Approximately 200 media representing more than 175 media outlets in North Central Texas
- Any person who asked to be on the mailing list.

A total of 8 newsletters have been produced and distributed on behalf of the Region C Water Planning Group during the fourth round of water planning. Appendix T includes copies of the Region C newsletters. The newsletters are distributed electronically to about 600 emails users, and about 1,625 paper copies of each newsletter are distributed by mail. The newsletters are also posted on the Region C web site.

Media Outreach

The media outreach plan for Region C called for using a number of communication vehicles to keep the media, and hence the public, informed of the progress and activities of the Region C Water Planning Group:

- **Newsletters.** Newsletters were sent to approximately 200 media representing more than 175 media outlets in North Central Texas, as well as to members of the general public on the mailing list.
- **Public hearings.** The media were invited through printed public meeting notices and press releases to attend the public hearings regarding the approval of the scope of work and the Initially Prepared Plan.
- **Press materials.** Updated press kit materials on Region C's water planning effort were developed during the fourth round of Regional Water Planning and provided to media throughout the planning period. The press kit includes frequently asked questions and answers, a summary of the planning process, list of key water management strategies under consideration, Regional Water Planning fact sheet, list of RCWPG members and contact information, copies of the newsletters, and a glossary of key water planning terms.
- **Press releases and media advisories.** Press releases and/or media advisories were issued prior to every meeting of the RCWPG during the fourth round of regional water planning. These notices alerted the media of the opportunity to attend and cover these public meetings, as well as requesting the media to include meeting notices in their public calendars to encourage public attendance and participation.
- **Ongoing media relations.** Among other key media outlets, reporters from *The Dallas Morning News*, *Star-Telegram, Dallas Business Journal* and *Fort Worth Business Press* have been proactive in attending the public meetings and have diligently covered the issues and activities surrounding the Region's water planning efforts. Significant coverage of Region C water planning efforts has also appeared in countless other community newspapers, magazines, websites and blogs.

The Region C Water Planning Group and its efforts have netted a significant amount of press coverage since the fourth round of water planning began. The following are some of the media outlets that have produced stories on the Region C planning process in the last few years:

- Allen American
- Athens Daily Review
- Azle News
- Bonham Daily Favorite
- Bridgeport Index
- Carrollton Reader
- Celina Record
- Colleyville Courier
- Collin County Business Press
- Coppell Gazette
- Corsicana Daily Sun
- D Magazine
- Dallas Business Journal
- Dallas Morning News
- Denton Record-Chronicle
- Flower Mound Leader
- Fort Worth Business Press
- Fort Worth Star-Telegram
- Fort Worth Weekly
- Frisco Enterprise
- Gainesville Daily Register
- Grapevine/Colleyville/Southlake Community Impact News
- Greenville Herald Banner
- KDFW Fox 4 TV
- KRLD News Radio 1080 AM
- KTVT CBS-11 TV
- KXAS NBC-5 TV
- Lewisville Leader
- Little Elm Journal
- Longview News Journal
- Lufkin Daily News
- McKinney Courier-Gazette
- Mesquite News
- Mount Pleasant Daily Tribune
- Nacogdoches Daily Sentinel
- North Texas e-News
- Oak Cliff Tribune
- Plano Star-Courier
- Rowlett Lakeshore Times
- Sanger Courier
- Sherman Herald-Democrat

- Texarkana Gazette
- Texas Tribune
- Tyler Morning Telegraph
- WBAP 820 AM
- WFAA Channel 8
- Wise County Messenger
- Wylie News.

Region C Web Site

In order to make the *2016 Initially Prepared Region C Water Plan* more accessible to the public, the draft plan was made available on the Region C web site, www.regioncwater.org, in May 2015. The web site has been used extensively throughout the fourth round of regional water planning, with all key documents uploaded to the site for public review. The site has also provided updates on upcoming meetings and key dates in the water planning process, as well as contact information for RCWPG members and consultants.

Members of the public have the opportunity to view current and past issues of the RCWPG newsletter on the web site. Members of the press have also been able to access press kit materials and submit requests for press kits or interviews via the web site.

This Final *2016 Region C Water Plan* is also publicly available on the Region C web site as required.

10.4 Public Meetings and Public Hearings

Initial Public Hearing

As required by Senate Bill One rules, the Region C Water Planning Group held an initial public hearing to discuss the planning process and the scope of work for the region on April 25, 2011. The scope of work was approved by the Region C Water Planning Group. The public were notified by the notice that was published in accordance with Texas Water Development Board (TWDB) guidelines [(1)].

Regular Public Meetings

The Region C Water Planning Group held regular meetings during the development of the plan, receiving information from the region's consultants and making decisions on planning efforts. These meetings were open to the public, proper notice was made under Senate Bill One guidelines [(1)], and these meetings met all requirements of the Texas Open Meetings Act. All of the Region C Water Planning Group meetings were held at the Trinity River Authority (TRA) Central Wastewater Treatment Plant in Grand Prairie, a central location in the region. The water planning group met regularly, approximately every two to three months. The following is a list of the dates of the Region C Water Planning Group meetings during this round of planning:

- March 21, 2011
- October 25, 2011
- April 30, 2012
- December 3, 2012
- March 25, 2013
- August 5, 2013
- December 2, 2013
- March 31, 2014
- May 19, 2014
- August 18, 2014
- October 27, 2014
- January 26, 2015
- March 2, 2015
- April 20, 2015
- September 28, 2015
- November 9, 2015

Public Hearing on Initially Prepared Plan

The public hearing on the *2016 Initially Prepared Region C Water Plan* was held on June 24, 2015, at the Bob Duncan Community Center in Arlington. Official public notice was posted in accordance with the TWDB requirements (1) and the public meeting met all requirements of the Texas Open Meetings Act.

Public Input

The Region C Water Planning Group encouraged the public to participate in the planning process by providing an opportunity for the public to speak to the Group at each public meeting during the planning cycle. The public was allowed to address the planning group on each action item prior to the Group taking action. The public was also invited to speak on any topic prior to the conclusion of each meeting.

After the May 1, 2015 submittal of the Initially Prepared Plan (IPP) to TWDB, Region C distributed copies of the IPP to the required locations, including county clerks offices in all 16 Region C Counties and at least one public library in each of the 16 Region C Counties. These copies were made available to the public at these locations at least 30 days prior to the June 24, 2015 Public Hearing. Public notice for this hearing was made as required by TWDB (TAC 357.21), including notices in both the Dallas Morning News and the Fort Worth Star Telegram. In this public notice, the public was made aware of: where to access the IPP, the opportunity to comment on the IPP at the June 24, 2015 public hearing, and the opportunity to submit written comments up to 60 days after the public hearing (through August 24, 2015).

The public was invited to speak to the Planning Group at all of the public hearings. Oral comments at the public hearing regarding the IPP were recorded by a court stenographer and are included in Appendix V of this report. Written comments were also accepted by the planning group and are included in Appendix V of this plan. Responses to the written comments are incorporated in Appendix W.

10.5 Region C and the Region D Interregional Conflict in the 2011 Regional Plans

The following text in an excerpt from the May 19, 2014 TWDB Executive Administrator (EA) final recommendation on Conflict, Background section (2).

Senate Bill I (SB 1) in 1997 created the current state water planning process. Before the implementation of SB 1, Marvin Nichols was recommended as a water management strategy in the 1968 State Water Plan, the 1984 State Water Plan, and the 1997 State Water Plan. Under SB 1, the first Region D Regional Water Plan in 2001 recommended that Marvin Nichols be developed to provide a source of future water supply for water users both within Region D and in Region C. The 2001 Plan was later amended to remove support for the development of Marvin Nichols, however. The 2006 Region D Regional Water Planning Group took the position that Marvin Nichols should not be included in any regional plan or in the State Water Plan as a water management strategy. Further, the Region D Regional Water Planning Group expressed the opinion that the inclusion of Marvin Nichols in the Region C Regional Water Plan constituted an interregional conflict. Following the policy established with the first series of water plans, the Texas Water Development Board (TWDB) approved both the Region C and Region D 2006 Regional Water Plans because it did not find an over-allocation of a source of supply--the TWDB's definition of an interregional conflict.

In 2007, the 80th Legislature established a study commission on Region C Water Supply that consisted of members appointed by the regional water planning groups of Regions C and D. The Study Commission was charged with reviewing the water supply alternatives available to the Region C Regional Water Planning Area. But the Study Commission was unable to reach a consensus on its findings and recommendations, so a final report was not delivered to the 82nd Legislature.

In 2011, the Region C Regional Water Planning Group again adopted Marvin Nichols as a recommended strategy and Region D reiterated concerns it had raised previously. Region D again expressed the opinion that including Marvin Nichols in the Region C Regional Water Plan constituted an interregional conflict. The TWDB approved the Region D Regional Water Plan in October 2010, and the Region C Regional Water Plan in December 2010, finding again that there was no over-allocation of supply sources. To date, Marvin Nichols has not been constructed and no permits for its development have been sought from the Texas Commission on Environmental Quality (TCEQ) or the U.S. Corps of Engineers.

Private parties in Region D (Ward Timber et al) filed suit in District Court in Travis County in January 2012, seeking judicial review of the TWDB's decision approving the Region C Regional Water Plan. In its order issued on December 5, 2011, the District Court declared that an interregional conflict existed, reversed the TWDB's decisions approving the two regional plans, and remanded the case to the TWDB for resolution. The TWDB appealed. The 11th Court of Appeals heard the case and affirmed the district court's ruling on May 23, 2013. No further motions were filed.

The TWDB contracted for a mediator and arranged for a mediation between Region C and Region D members appointed by their respective regional planning groups. The mediator reported on December 17, 2013 that the parties did not reach agreement in the mediation. Thus, under the statute and the Court's Order, the TWDB is to resolve the conflict.

The core dispute between Region C and Region D is whether Marvin Nichols should be developed in the north-central part of Region D to serve the water needs in Region C.

Timeline of Conflict and Resolution

The following text is from the TWDB web site [3].

March 4, 2014 *- The preliminary recommendation from TWDB EA (Kevin Patteson) is posted on the agency website and provided to the chairs of the C and D regional water planning groups and the parties to the Ward Timber litigation through their attorney. The TWDB begins receiving comments.*

April 29 and 30, 2014 *- public hearings for Region D and Region C on the preliminary recommendation.*

May 2, 2014 *- Comment period on Preliminary Recommendation closed.*

May 19, 2014 *- The Executive Administrator submits a final recommendation to the Board and issues a letter soliciting briefs.*

August 7, 2014 *- Board considered TWDB Executive Administrator's final recommendation.*

On August 7, 2014, the Board considered TWDB Executive Administrator's final recommendation regarding the interregional conflict between the Region C and Region D Regional Water Plans. The Board determined that there was inadequate analysis and quantification of the impact of the Marvin Nichols Reservoir Water Management Strategy on the agricultural and natural resources of Region D and the State.

August 8, 2014 *- Board Interim Order issued.*

On August 8, 2104 it was ordered that Region C conduct such analysis and quantification and submit same to the Board by November 3, 2014. It was further ordered that upon receipt of the analysis and quantification, the Executive Administrator and Region D would be given the opportunity to submit a written response to the submission, and the matter would be scheduled for Board consideration.

November 3, 2014 *- Additional quantitative analysis of agricultural and natural resource impacts of the Marvin Nichols Water Management Strategy by Region C due to TWDB.*

Region C submitted its analysis and quantification to the Board on October 29, 2014

December 17, 2014 *- Region D and the Executive Administrator responded to Region C's quantitative analysis.*

***January 8, 2015** – Order issued by the Texas Water Development Board. The Board found that Region C's 2011 Regional Water Plan together with the analysis and quantification submitted on October 29, 2014, meets the applicable statutory and regulatory criteria. Further, the Board found that in accordance with Texas Water Code (TWC) §§ 16.051 and 16.053, the interregional conflict as asserted by Region D is hereby resolved with the inclusion of the Marvin Nichols Reservoir Project as a recommended water management strategy in the 2011 Region C Regional Water Plan.*

Pursuant to the January 8, 2015, TWDB Order, Region C revised the *2011 Region C Water Plan* to reflect the conflict resolution. In addition, a public hearing was held on February 27, 2015 at the Bob Duncan Community Center in Arlington to solicit public comment on the proposed revisions to the 2011 Region C Water Plan based on the Board's January 8, 2015 order. There was one individual in attendance and there were no public comments. One written comment was received.

A Region C Water Planning Group meeting was held on March 2, 2015 to consider approval and adoption of the revisions to the *2011 Region C Water Plan*, related to TWDB's final resolution of the interregional conflict between Region C and Region D regarding the Marvin Nichols Reservoir Water Management Strategy. The group unanimously adopted the revisions to the 2011 Plan. The proposed revisions and the transcript from the public hearing were submitted to the TWDB on March 11, 2015. All of the items related to the interregional conflict can be found on the Region C web site (regioncwater.org), as well as the TWDB's web site (http://www.twdb.texas.gov/home/tabs/doc/hot/RegionCandDConflict.asp).

10.6 Region C and the Region D Interregional Conflict in the 2016 Initially Prepared Regional Plans

All documents pertaining to the 2016 Interregional Conflict Resolution are included in Appendix Z. Underlined items in the text below indicate a document that is included in Appendix Z.

The *2016 Initially Prepared Region C Water Plan* (IPP) contained a strategy called "Sulphur Basin Supplies" which consisted of the combination of supply from raising the conservation pool at Lake Wright Patman (to elevation 232.5 msl) and from a proposed Marvin Nichols Reservoir at elevation 313.5 msl (41,722-acre footprint). In the IPP, Sulphur Basin Supplies was a recommended strategy for Tarrant Regional Water District, North Texas Municipal Water District, and Upper Trinity Regional Water District, and was an alternative strategy for the cities of Dallas and Irving. This strategy was shown to be online by 2050.

On July 21, 2015, the Region D (North East Texas) Water Planning Group notified TWDB (by letter) of their objection to the inclusion of the Marvin Nichols Reservoir in the 2016 Region C Initially Prepared Plan. On August 6, 2015 TWDB responded with a memorandum to Regions C and D regarding a Potential Interregional Conflict between Regional Water Plans for Regions C and D. In this memo, TWDB invited

Regions C and D to submit briefs on the issue of whether an interregional conflict exists and notified the Regions that TWDB (the Board) would consider the matter of whether an interregional conflict did exist at its Board Meeting on September 9, 2015. Each Region was invited to give a 15 minute oral presentation to the TWDB Board at that meeting.

On August 24, 2015 Region C submitted a letter brief to TWDB asserting that an interregional conflict did not exist on the basis that the Board had previously reviewed and resolved the interregional conflict in the 2011 Regional Plan ruling in favor of keeping the Marvin Nichols strategy in the regional plan (See Section 10.5 above). On September 1, 2015 the Sulphur River Basin Authority (SRBA) submitted a letter to TWDB regarding the Potential Interregional Conflict between Regional Water Plans for Region C and D. In this letter, SRBA added its support of the Marvin Nichols Reservoir being included in the regional plans, stating that “it is crucial that all the water supply strategies in the Sulphur River Basin Feasibility Study that are listed in the Texas State Water Plan remain in the plan”.

On September, 9, 2015 TWDB held a Board meeting at which the Board heard presentations from both Region C and D. The minutes from this meeting reflects that TWDB found that an interregional conflict did exist between the 2016 Region C and Region D Initially Prepared Plans and set forth a path by which Regions C and D would participate in mediation to resolve the conflict. TWDB directed each region and TWDB to designate representatives to participate in this mediation. At its September 28, 2015 public meeting, the Region C Planning Group designated four representatives to participate in this mediation.

Mediation took place on October 5, 2015 resulting in an agreement to resolve the conflict. The terms of the agreement are as follows:

- Region C will move the Marvin Nichols Reservoir as a designated strategy to the year 2070 in its 2016 regional water plan;
- Region C will support Region D’s effort to obtain Texas Water Development Board funding to study alternative water supplies to Marvin Nichols Reservoir for the process of the 5th cycle of regional water planning for Regions C and D, resulting in the development of the 2021 regional water plans;
- Region C will adopt a resolution to recommend that water suppliers in Region C not submit any water rights applications for new reservoirs that would be located in Region D through the end of the 5th cycle of regional water planning; and
- Region D agrees that it will not challenge Marvin Nichols Reservoir as a unique reservoir site through the end of the 5th cycle of regional planning.

Both Regions C and D were to seek ratification of the agreement by their respective regional water planning groups and to seek inclusion of the language relating to the terms of the agreement in their region's adopted 2016 regional water plans. At their November 9, 2015 public meeting the Region C Water Planning Group adopted two resolutions, one ratifying the mediation agreement and the other recommending that water suppliers in Region C not submit any water rights applications for new reservoirs that would be located in Region D through the end of the 5th cycle of regional water planning. Revisions were made to the final 2016 Region C Water Plan to reflect the terms of the agreement, particularly that the Marvin Nichols Reservoir portion of the Sulphur Basin Supplies strategy was moved to begin in 2070 rather than 2050. The Wright Patman portion of the Sulphur Basin Supplies strategy is still shown beginning in 2050.

CHAPTER 10
LIST OF REFERENCES

(1) Texas Water Development Board, *Exhibit C First Amended General Guidelines for Regional Water Plan Development* (October 2012), Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2016/doc/current_docs/contract_docs/2012_exhC_1st_amended_gen_guidelines.pdf, January 28, 2013.

(2) Patteson, K. *Resolution of the Interregional Conflict between the 2011 Region C and the Region D Regional Water Plans* [Memorandum]. Austin: Texas Water Development Board. [Online] Available URL: http://www.twdb.state.tx.us/board/2014/08/Board/Brd01.pdf, December 19, 2014.

(3) Texas Water Development Board, *Region C and Region D Interregional Conflict* (January 2015), Austin, [Online] Available URL: http://www.twdb.texas.gov/home/tabs/doc/hot/RegionCandDConflict.asp, February 3, 2015.

11 Implementation and Comparison to Previous Regional Water Plan

11.1 Introduction

One of the new requirements for the 2016 Regional Water Plans is the inclusion of a chapter providing a comparison of the current regional water plan to the previous plan and a discussion of the differences between the two. This chapter includes a description of the water management strategies (WMSs) that were included in the previous plan (*2011 Region C Water Plan* [1]) and have been implemented since the previous plan was published, as well as strategies that are no longer considered. It also includes a discussion on the differences between the two plans, specifically regarding:

- Water demand projections,
- Drought of record and hydrologic modeling and assumptions used in planning for the region,
- Groundwater and surface water availability, existing water supplies, and identified water needs for Water User Groups (WUGs) and Wholesale Water Providers (WWPs),
- Recommended and alternative water management strategies, and
- Cost of the proposed plan.

Each of these topics is discussed in the sections below.

11.2 Implemented and No Longer Included Water Management Strategies

The following sections discuss the WMSs that were recommended in the *2011 Region C Water Plan* (2011 Plan) and have been partially or completely implemented since that plan was published, as well as WMSs that are no longer being considered and are not included in the 2016 Plan. Changes to WMSs since the 2011 Plan are discussed in Section 11.3.6.

11.2.1 Implementation of Previously Recommended Water Management Strategies

Table 11.1 lists the 30 WMSs that have been fully or partially implemented since the 2011 Plan. Because conservation was a recommended strategy for a large number of WUGs and WWPs in the 2011 Plan, it is discussed separately below and is not listed by WUG/WWP in Table 11.1. Additional information on conservation as a WMS is included in Section 11.3.6.

Since the 2011 Plan, Region C WUGs have made significant progress in the implementation of recommended water conservation strategies. A summary of the conservation water management strategies recommended in the 2011 Plan is included in Section 5E.1 of this report. A description of existing conservation in Region C and the level of implementation since the 2011 Plan can be found in Section 5E.6. Based on survey responses, the most widely implemented municipal water conservation strategies are water system audits, leak detection and repair; time-of-day watering restrictions; and education programs (Table 5E.6).

Region C did not consider drought management as a feasible strategy to meet long-term growth in demands or currently identified needs in either the 2011 or 2016 Plan so the implementation of this strategy is not relevant to the discussion in this Chapter. The drought management WMS is discussed in more detail in Section 7.6 of this report.

11.2.2 Water Management Strategies No Longer Considered

Table 11.2 lists water management strategies that were considered as recommended or alternative WMSs in the 2011 Plan, but are not included in the 2016 Plan as a WMSs. There are a number of alternative WMSs that large WWPs considered in the 2011 Plan, but are no longer considering. Overdrafting of aquifers and supplemental wells are other WMSs that were considered for several entities in the 2011 Plan, but are no longer WMSs for any entities in the 2016 Plan. The entities that had supplemental wells as a WMS in the 2011 Plan are not listed in Table 11.2 because of the large number of entities with this WMS. The supplemental well WMS is discussed in more detail below.

In prior Region C Plans, supplemental wells (or replacement wells) were included as recommended water management strategies for all WUGs and WWPs that had a groundwater supply. There were 184 WUGs and WWPs with supplemental wells as a WMS in the 2011 Plan. Capital costs associated with these strategies reflected replacement of existing wells during the 50 year planning period. However, in this fourth cycle of regional planning, the regional planning rules explicitly prohibit the inclusion of replacement of existing infrastructure that does not provide additional volume of supply. These rules are specifically laid out in Section 5.1.2.3 of the Regional Planning Guidelines [(2)] as shown below.

Table 11.1
Water Management Strategies Implemented Since the 2011 Region C Water Plan[a]

Sponsor	Project Name	Source of Supply
Ables Springs WSC	Connect to NTMWD and Purchase Water	NTMWD
Aledo	Connect to Fort Worth (TRWD)	TRWD
Alvord	Water from West Wise SUD (TRWD)	TRWD
Arlington	Fort Worth Direct (Reuse)	Fort Worth
Aurora	Rhome (from Walnut Creek SUD and TRWD)	TRWD & Walnut Creek SUD
Bardwell	Rockett SUD	Rockett SUD (TRWD and Midlothian)
Cooke County Irrigation	Moss Lake (Gainesville)	Gainesville
Corsicana	Pump Station from Richland-Chambers and New WTP (Lake Halbert) [b]	Richland-Chambers Reservoir
Dallas	Direct Reuse supplies [c]	Reuse
Denton County Irrigation	New wells in Trinity Aquifer	Trinity Aquifer
Denton County Irrigation	New wells in Woodbine Aquifer	Woodbine Aquifer
Denton County Mining	New wells in Trinity Aquifer	Trinity Aquifer
Ellis County Irrigation	New wells in Woodbine Aquifer	Woodbine Aquifer
Euless	Fort Worth Direct Reuse	Fort Worth
Fort Worth	Village Creek Direct Reuse	Fort Worth
Fort Worth	New 12 MGD West Water Treatment Plant	TRWD
Gainesville	Moss Lake raw water and WTP [c]	Part of the Cooke County WSP (now referred to as Gainesville).
GTUA	Lake Texoma Pump Station expansion	Lake Texoma
Kaufman County Steam Electric Power	Additional NTMWD treated water through Forney	NTMWD
Kennedale	New wells in Trinity Aquifer	Trinity Aquifer
Lake Worth	New wells in Trinity Aquifer	Trinity Aquifer
Midlothian	New 9 MGD WTP	TRWD
Navarro Mills WSC	New wells in Woodbine Aquifer	Woodbine Aquifer
NTMWD	Texoma Pump Station Expansion	Lake Texoma
Palmer	Rockett SUD (TRWD)	TRWD
Pilot Point	New wells in Trinity Aquifer	Trinity Aquifer
Sardis-Lone Elm WSC	Rockett SUD (TRWD)	TRWD
Southmayd	New wells in Woodbine Aquifer [c]	Woodbine Aquifer
Terrell	Additional water from NTMWD - New pipeline	NTMWD
TRWD	Integrated Pipeline and Reuse [c]	Richland-Chambers Reuse

(a) Not considering conservation strategies.
(b) Pump station from Richland-Chambers is completed. New WTP is still a WMS.
(c) Partially implemented. For the TRWD strategy, the Integrated Pipeline portion is yet to be implemented and there is additional reuse yet to be implemented.

5.1.2.3 Infrastructure/Costs That Shall Not be Included in Regional Water Plans

"If an infrastructure component is not required to increase the treated water supply volume delivered to a WUG either as new supply or through demand reduction, the component and its costs shall not be included in the RWP. Types of items and associated cost that *shall not* be incorporated into a RWP included, but are not limited to: …New wells that are required simply to replace aging wells (i.e., maintenance)."

It is Region C's understanding that supplemental wells are not permitted to be included in the 2016 Regional Water Plans, consequently they have not been included and are no longer considered a WMS. However, the planning group believes that the replacement of aging infrastructure, like wells, is an important part of maintaining an adequate water supply. Such projects should be considered consistent with this plan and supported by adequate state funding, where needed.

11.3 Differences Between the Previous and Current Regional Water Plan

The following sections provide a discussion of changes from the 2011 Plan to the 2016 Plan.

11.3.1 Water Demand Projections

As shown in Table 11.3 and Figure 11.1, the water demand projections in the *2016 Region C Water Plan* are lower than the projected demands in the 2011 Plan. The largest change occurred with respect to municipal demand projections. One reason for the decreased demands is increased conservation across the region. The total municipal 2060 gallons per capita per day (gpcd) in the 2011 Plan was 200 as opposed to the total municipal gpcd of 165 in the 2016 Plan. (It should be noted that these gpcd's reflect demands before any conservation water management strategies have been applied). Much of the conservation that was included as water management strategies in the 2011 Plan has been achieved and is now reflected as a reduction in demand. Another reason for the decreased demands is the fact that the municipal water demand projections presented in this Plan are based on per capita dry-year water use from year 2011 data because TWDB asserted that 2011 represented the most severe drought year in recent history for the majority of the state of Texas, although 2011 was not the most severe recent drought year for much of Region C. For many Region C water user groups, 2006 and 2008 were more representative of dry-year, high-demand conditions than 2011. (In parts of Region C, unlike most of Texas, there were periodic light rains in the summer of 2011 that suppressed the demand for water.) The Region C consultants suggested that the dry-year per capita demands should be based on the highest per capita use in recent years and then reduced over time to reflect savings from low flow water fixtures. TWDB staff did not agree. As a result, it is the opinion of the Region C consultants that the projected dry-year demands for some Water User Groups in Region C underestimate true dry-year needs. This is one of the main reasons for the large decrease in demands from the 2011 Plan.

There were several changes to the non-municipal demand projections since the 2011 Plan. Nearly all of the non-municipal demand projections (with the exception of the Steam Electric Power demand in 2020) decreased from the 2011 Plan. This is mainly due to the inclusion of more recent historical use data as the basis for the projections. Table 11.4 shows the changes in demand projections from the 2011 Plan by type of use.

Table 11.2
Water Management Strategies No Longer Considered in the 2016 Region C Water Plan
(Not Including Supplemental Wells)

Sponsor	Project Name	Comments
Athens MWA	Forest Grove Reservoir and WTP	Was recommended, no longer a WMS
Azle	3 MDG WTP Expansion (TRWD)	Three WTP expansions were included in the 2011 Plan; Only 1 expansion is included in the 2016 Plan
Bardwell	Ennis (TRWD through TRA)	Was recommended, no longer a WMS
Buena Vista-Bethel SUD	Overdraft from Trinity Aquifer	Was recommended, no longer a WMS
Collin County Mining	Additional water from NTMWD	Was recommended, no longer a WMS
Cooke County Irrigation	Overdraft Trinity Aquifer, Direct Reuse	Was recommended, no longer a WMS
Cooke County Mining	Overdraft Trinity Aquifer (existing wells)	Was recommended, no longer a WMS
Corsicana	Purchase water from TRWD	Was recommended, no longer a WMS. No longer anticipated to need TRWD water prior to 2070.
Corsicana	Raw Water for Second Proposed Power Plant	Was recommended, no longer a WMS.
Crandall	Dallas Water Utilities	Was recommended, no longer a WMS.
Dallas	Wright Patman	Was recommended, now alternative WMS in combination with Marvin Nichols
Dallas	Direct reuse	A portion was implemented; a portion was moved to an alternative WMSs; a portion is no longer being considered
Dallas	Lake Ray Hubbard Operational Efficiency Supply	Was recommended, no longer a WMS. Dallas is still planning to develop this, but since it does not provide additional reliable supply it has not been included in this plan.
Dallas	Additional dry year supply	Was recommended, no longer a WMS
Dallas	George Parkhouse North	Was alternative, no longer a WMS
Dallas	George Parkhouse South	Was alternative, no longer a WMS
Dallas	Oklahoma	Was alternative, no longer a WMS
Dallas	Roberts County GW	Was alternative, no longer a WMS
Dallas	Lake Texoma - Elm Fork	Was alternative, no longer a WMS
Dallas	Lake Texoma - Blend	Was alternative, no longer a WMS
Dallas	Lake O' the Pines	Was alternative, no longer a WMS

Sponsor	Project Name	Comments
Dallas	Lake Livingston	Was alternative, no longer a WMS
Dallas County Irrigation	Additional water from DWU	No longer a recommended WMS
Dawson	New WTP	Was recommended, no longer a WMS
Denton County Irrigation	TRA Direct Reuse	Was recommended, no longer a WMS
Denton County Mining	Additional water from groundwater	Was recommended, no longer a WMS
Denton County Other	Additional water from Fort Worth	Was recommended, no longer a WMS
Denton County other	Additional water from groundwater	Was recommended, no longer a WMS
Denton County Steam Electric Power	Additional Groundwater	Was recommended, no longer a WMS
Everman	Additional water from Fort Worth	Was recommended, no longer a WMS
Fairfield	New well in Carrizo-Wilcox Aquifer	Was recommended, no longer a WMS
Fort Worth	New 25 mgd Southwest Plant	Was recommended, no longer a WMS
Fort Worth	Southwest Plant 25 mgd expansion	Was recommended, no longer a WMS
Gainesville	Overdraft Trinity Aquifer (existing wells)	Was recommended, no longer a WMS
Grayson County Manufacturing	Additional Denison	Was recommended, no longer a WMS
Jack County Irrigation	Jacksboro Indirect Reuse to Mining	Was recommended, no longer a WMS
Jack County Mining	Jacksboro (Lost Creek/Jacksboro system)	Was recommended, no longer a WMS
Kaufman County Irrigation	Additional water from NTMWD	Was recommended, no longer a WMS
Kemp	Additional water from TRWD	Was recommended, now water comes through West Cedar Creek MUD
Kennedale	Additional water from Trinity Aquifer	Was recommended, no longer a WMS
Lakeside	Additional Trinity Aquifer wells	Was recommended, no longer a WMS
Little Elm	Additional Woodbine Aquifer wells	Was recommended, no longer a WMS
Marilee SUD	Additional Water from Grayson County WSP	Was recommended, WMS is now for Marilee to purchase additional water directly from Sherman rather than via the GCWSP
Melissa	Treated water supply from NTMWD	Was recommended, no longer a WMS
Mountain Peak SUD	Overdraft Trinity Aquifer in 2010	Was recommended, no longer a WMS
Navarro County Steam Electric Power	Corsicana	Corsicana will provide water for one power plant in the 2016 Plan. In the 2011 Plan, they were shown to provide water for two power plants.
Prosper	Additional water from UTRWD	Was recommended, no longer a WMS
Reno	Additional water from Springtown	Was recommended, no longer a WMS
Sanger	Additional water from Bolivar WSC	Was recommended, no longer a WMS
Sardis-Lone Elm WSC	Overdraft Trinity Aquifer (existing wells)	Was recommended, no longer a WMS
Tarrant County irrigation	Additional water from Reuse	Was recommended, no longer a WMS
Wortham	Corsicana	Was recommended, no longer a WMS
Wortham	TRWD	Was recommended, no longer a WMS
Wortham	WTP Expansion/Rehabilitation	Was recommended, no longer a WMS
NTMWD	Roberts County GW	Was alternative WMS, no longer a WMS
NTMWD	Renewed Interim GTUA	Was recommended, no longer a WMS
NTMWD	DWU Treated Water	Was alternative WMS, no longer a WMS

Sponsor	Project Name	Comments
NTMWD	Lake Livingston	Was alternative WMS, no longer a WMS
TRA	Additional Freestone County Raw Water (TRWD)	Was recommended, no longer a WMS
TRWD	Wright Patman - Texarkana	Was alternative WMS, no longer a WMS
TRWD	Wright Patman - Raise Pool	Was alternative WMS, no longer a WMS
TRWD	Lake Livingston	Was alternative WMS, no longer a WMS

Table 11.3
Changes in Projected Water Dry Year Demands from 2011 Plan to 2016 Plan for Region C by County

County	Change in Projected Water Dry Year Demand (Acre-Feet per Year)				
	2020	**2030**	**2040**	**2050**	**2060**
Collin	-62,350	-84,306	-99,327	-107,325	-118,665
Cooke	-1,145	-2,369	-3,327	-3,743	-3,244
Dallas	-173,210	-182,048	-168,205	-181,599	-233,187
Denton	-15,824	-28,440	-36,223	-41,935	-47,547
Ellis	-9,475	-13,691	-15,566	-13,747	-6,461
Fannin	2,221	1,510	938	651	2,043
Freestone	11,881	9,091	5,637	5,966	7,239
Grayson	-11,054	-11,091	-12,799	-13,632	-8,535
Henderson	1,067	-3,663	-4,555	-5,556	-3,637
Jack	592	802	761	772	781
Kaufman	-14,702	-17,434	-20,111	-18,945	-14,398
Navarro	-855	-858	-814	-250	628
Parker	-2,393	-5,208	-6,755	-474	11,097
Rockwall	-15,063	-14,976	-17,795	-16,009	-11,863
Tarrant	-44,669	-56,184	-67,636	-94,482	-143,658
Wise	-20,440	-23,882	-26,377	-26,176	-26,218
Region C Total	**-355,419**	**-432,747**	**-472,154**	**-516,484**	**-595,625**

Figure 11.1
Total Change in Projected Water Dry Year Demands from 2011 Plan to 2016 Plan

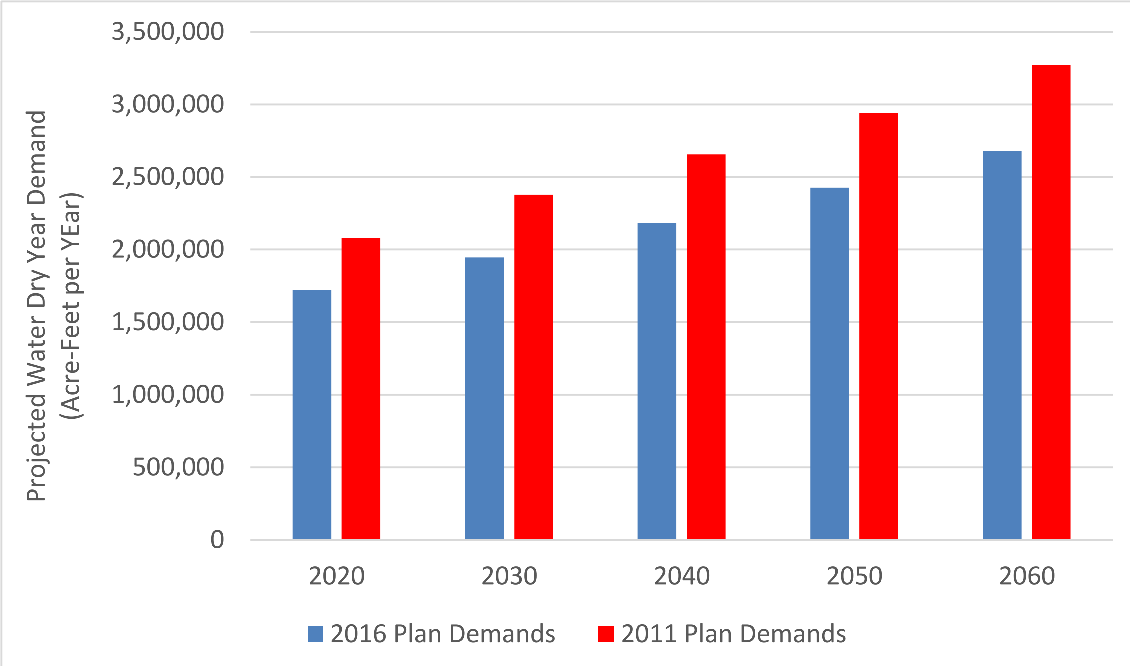

Table 11.4
Change in Projected Water Dry Year Demands from 2011 Plan to 2016 Plan by Type of Use

Use	Change in Projected Water Demand (Acre-Feet per Year)				
	2020	**2030**	**2040**	**2050**	**2060**
Municipal	-352,141	-412,212	-449,393	-492,363	-571,339
Manufacturing	-1,733	-2,052	-2,332	-2,501	-2,698
Steam Electric Power	6,827	-3,912	-1,361	-2,417	-2,427
Irrigation	-7,799	-7,782	-7,774	-7,781	-7,799
Mining	-103	-6,319	-10,824	-10,952	-10,892
Livestock	-470	-470	-470	-470	-470
Region C Total	**-355,419**	**-432,747**	**-472,154**	**-516,484**	**-595,625**

11.3.2 Drought of Record and Hydrologic Modeling Assumptions used in Planning for the Region

The drought of record for most water supplies used in Region C occurred from 1950 through 1957. The recent drought, which began in 2011, has caused low inflows and low water levels for many Region C lakes. Analysis using hydrologic data from recent years has indicated that Jim Chapman (Cooper) Lake in the Sulphur River Basin (outside of Region C) has recently experienced a new drought of record. This more recent hydrologic data was used to calculate a new firm yield of Jim Chapman Lake. For other Region C supplies, based on the current hydrology in the Texas Commission on Environmental Quality (TCEQ) Water Availability Models (WAMs), the drought of the 1950s remains the drought of record.

Unless there are changed conditions (new water rights, WAM modification, new area/capacity relationships, new drought of record, other), the firm yields from the 2011 Plan were used, extrapolating 2070 yields from 2060 yields. The Region C reservoirs for which new firm yields were calculated include the Elm Fork of the Trinity River System, Forest Grove Reservoir, and Lake Lavon. The Elm Fork System and Lake Lavon yields were updated to reflect new area-capacity relationships based on recent TWDB volumetric surveys. The yield for Forest Grove was updated to reflect that the gates on the dam at the reservoir have not been closed.

The modeling assumptions for run-of-river diversions were changed for the 2016 Plan. The local irrigation availability is based on existing run-of-the-river surface water rights for irrigation not associated with major reservoirs. In previous Region C Water Plans the reliable supply from run-of-the-river diversions was assumed equal to the permitted diversion for water rights located on the main stem of the river and 75 percent of the permitted diversion for water rights located on tributaries. In the 2016 Plan the reliable supply from run-of-the-river diversions was calculated using the WAM as the minimum monthly diversion for the permitted water rights located on the main stem and tributaries of the river. This revision decreased the local irrigation availability in the Red River Basin. Additional information on the hydrologic modeling assumptions can be found in Appendix I.

11.3.3 Groundwater and Surface Water Availability

As shown in Table 11.5, the total available supplies (not considering infrastructure or permit constraints) in the 2016 Plan are lower than the supplies presented in the 2011 Plan. This is largely due to the lower availability from surface water because of the use of safe yields by some of the larger WWPs. However, this is partially offset by greater availability from reuse in later decades due to the development of new reuse projects. Other contributing factors are the decreased yield of Chapman Lake using the new critical period of the reservoir and the decrease to the run-of-river supplies from changes in the calculations of those supplies as discussed in Section 11.3.2. The changes related to reuse are largely due to updates resulting in lower return flow factors used to estimate the reuse amounts which were offset by the implementation of several large reuse projects (TRWD Cedar Creek and Fort Worth Village Creek). The overall groundwater availability in the region is very similar to availability in the 2011 Plan. The changes in availability are chiefly due to changes to the availability from the Nacatoch, Queen City, and Carrizo-

Wilcox and other aquifers. Modeled Available Groundwater (MAG) estimates for these aquifers were not available for the 2011 Plan.

Table 11.5
Change in Total Available Supplies from the 2011 Plan to the 2016 Plan

Source of Supply	2020	2030	2040	2050	2060
Reservoirs	-59,254	-71,560	-83,866	-96,171	-108,475
Imports	5,447	-21,407	-28,291	-35,065	-40,937
Run-of-the-River/Local	-15,241	-15,241	-15,241	-15,241	-15,241
Groundwater	26	38	36	-17	-20
Reuse	37,384	26,978	30,255	58,647	72,799
Total	**-31,638**	**-81,192**	**-97,107**	**-87,846**	**-91,874**

11.3.4 Existing Water Supplies of WUGs

Changes to the existing water supplies for WUGs are summarized in Table 11.6 and Table 11.7. Table 11.6 summarizes the current supplies shown in the 2011 Plan that are no longer a supply for the respective WUG. Many of these changes are due to WUGs no longer using groundwater and local supplies. Table 11.7 lists the WUGs with new supplies since the 2016 Plan. Some of these changes are due to new information received from the WUGs since the 2011 Plan. Other changes are from the implementation of new water supplies.

Table 11.6
Existing Supplies in 2011 Plan that Are no Longer a WUG Supply

WUG	Source of Supply in 2011 Plan - No Longer a Supply in 2016 Plan
Ables Springs	SRA
Arlington	Lake Arlington (TRWD). Supply is now dedicated to TRWD by contract and is part of the TRWD System supply to Arlington.
Aubrey	Trinity Aquifer
Balch Springs	Dallas County WCID #6 (DWU)
Collin County Irrigation	Other Aquifer
Collin County Livestock	Other Aquifer
Collin County Mining	Local supplies, NTMWD
Cooke County Irrigation	Other Aquifer
Cooke County Mining	Local Supplies
Cooke County Other	Local Supplies
Dallas County Irrigation	Other Aquifer
Dallas County Manufacturing	Direct Reuse
Dallas County Mining	Woodbine Aquifer, Other Aquifer
Dallas County Steam Electric Power	NTMWD
Denison	Trinity Aquifer

WUG	Source of Supply in 2011 Plan - No Longer a Supply in 2016 Plan
Denton County Mining	Local Supplies
Denton County Other	Fort Worth (TRWD), Other Aquifer
Ellis County Irrigation	Reuse
Ellis County Other	Other Aquifer
Everman	Fort Worth (TRWD)
Freestone County Livestock	Other Aquifer, Queen City Aquifer
Freestone County Other	TRWD
Grayson County Mining	Woodbine Aquifer
Grayson County Other	Other Aquifer
Gun Barrel City	Mabank (TRWD)
Hackberry	Trinity Aquifer
Henderson County Livestock	Other Aquifer
Henderson County Other	Other Aquifer
Jack County Irrigation	Indirect Reuse
Jack County Other	Jacksboro (Lost Creek/Jacksboro system), Trinity Aquifer
Kaufman County Irrigation	Trinity Aquifer, NTMWD
Kaufman County Livestock	Woodbine Aquifer
Keller	Trinity Aquifer
Kemp	TRWD
Little Elm	Woodbine Aquifer
Marilee SUD	Grayson County WSP
Navarro County Livestock	Other Aquifer
Navarro County Other	Woodbine Aquifer
North Richland Hills	Trinity Aquifer
Reno	Springtown (TRWD)
Rockwall County Irrigation	Direct Reuse
Rockwall County Livestock	Other Aquifer
Rockwall County Mining	Local Supplies
Rockwall County Other	Other Aquifer
Sanger	Bolivar WSC
Southmayd	Trinity Aquifer
Van Alstyne	Trinity Aquifer
Venus	Trinity Aquifer (Region G)
Wise County Manufacturing	Other Aquifer
Wortham	Bistone Municipal WSD (Carrizo-Wilcox, Limestone County, Region G)

Table 11.7
New Existing Supplies Since the 2011 Region C Water Plan

WUG	New Existing Supply Since 2011 Plan
Ables Springs	NTMWD
Aledo	Fort Worth (TRWD)
Alvord	West Wise SUD (TRWD)
Arlington	Fort Worth (Reuse)
Aurora	Rhome (Walnut Creek SUD and TRWD)
Balch Springs	DWU - No longer through Dallas County WCID #6
Bardwell	Rockett SUD
Bryson	Other Aquifer
Collin County Irrigation	Woodbine Aquifer
Cooke County Irrigation	Woodbine Aquifer, Moss Lake (Gainesville)
Cooke County Livestock	Woodbine Aquifer
Dallas	Indirect Reuse Supplies
Dallas County Irrigation	Trinity Aquifer, Woodbine Aquifer
Dallas County Manufacturing	Grand Prairie
Dallas County Other	TRWD Sources for DFW Airport, Fort Worth Reuse Sources for DFW Airport
Denton County Irrigation	Trinity Aquifer
Denton County Manufacturing	Northlake (TRWD Sources)
Denton County Other	Little Elm (NTMWD)
Denton County Steam Electric Power	Denton (Lake Lewisville)
Ellis County Irrigation	Woodbine Aquifer
Ellis County Other	Rockett SUD (Midlothian), Rockett SUD (TRWD), Waxahachie (Lake Bardwell), Waxahachie (Reuse), Ennis (TRWD)
Ennis	Rockett SUD (Midlothian Sources), Rockett SUD (TRWD Sources)
Euless	Fort Worth Direct Reuse
Fannin County Irrigation	Woodbine Aquifer
Fannin County Livestock	Other Aquifer
Ferris	Rockett SUD (Midlothian)
Freestone County Manufacturing	Carrizo-Wilcox Aquifer (Teague & Fairfield)
Freestone County Other	Corsicana
Glenn Heights	Woodbine Aquifer
Grand Prairie	TRWD (Mansfield, Midlothian)
Grayson County Irrigation	Trinity Aquifer
Grayson County Livestock	Trinity Aquifer
Grayson County Mining	Red River Authority (Lake Texoma)

WUG	New Existing Supply Since 2011 Plan
Henderson County Manufacturing	Athens Groundwater, Carrizo-Wilcox Aquifer (through Malakoff)
Jack County Manufacturing	Bryson
Kaufman County Manufacturing	Trinity Aquifer
Kaufman County Mining	Trinity Aquifer
Kaufman County Other	Woodbine Aquifer, DWU (through Combine WSC through Seagoville)
Kaufman County Steam Electric Power	NTMWD Treated Water (through Forney)
Kemp	West Cedar Creek MUD (TRWD)
Marilee SUD	Sherman
Mustang SUD	Woodbine Aquifer
Navarro County Mining	Trinity Aquifer
Navarro County Other	Trinity Aquifer
Navarro Mills WSC	Woodbine Aquifer
Oak Point	Trinity Aquifer
Palmer	Rockett SUD (TRWD & Midlothian)
Parker County Irrigation	Weatherford
Parker County Manufacturing	Walnut Creek SUD (TRWD)
Parker County Other	Local Supplies, Walnut Creek (TRWD)
Payne Springs	East Cedar Creek FWSD (TRWD)
Prosper	Trinity Aquifer, Woodbine Aquifer, UTRWD
Sanger	UTRWD
Sardis-Lone Elm WSC	Woodbine Aquifer, Rockett SUD
Southmayd	Woodbine Aquifer
Tarrant County Irrigation	Woodbine Aquifer
Tarrant County Manufacturing	Trinity Aquifer
Tarrant County Other	Fort Worth Reuse, DWU
Wise County Manufacturing	Trinity Aquifer
Wortham	Mexia

11.3.5 Identified Water Needs for WUGs and WWPs

The 2060 water needs for WUGs and WWPs in the 2011 Plan were 784,758 and 2,333,436 acre-feet per year, respectively. The WUG needs do not include the needs for entities like Dallas, Fort Worth, Corsicana, etc. that are both a WUG and a WWP. The needs for these entities are included with the WWP needs. The total 2060 need from the 2011 Plan was 1,588,236 acre-feet per year. This total need is different from the numbers presented above because the WWP needs can double or triple count the WUG needs in many cases. For example, if the water is sold through multiple WWPs before it gets to the end user, the water is counted each time it passes through an entity.

The total 2060 need in the 2016 Plan is over 1.09 million acre-feet per year. This need is less than the need shown in the 2011 Plan because of the decreased demands in the 2016 Plan and the implementation of additional sources since the 2011 Plan.

11.3.6 Recommended and Alternative Water Management Strategies

In addition to the implemented and no longer considered WMSs discussed in Section 11.2, there have been numerous changes to the recommended and alternate water management strategies presented in the 2011 Plan. These changes are summarized in Table 11.7. Table 11.7 does not include the 21 new WUGs added since the 2011 Plan. In addition, the table does not include the ten WUGs that are no longer considered WUGs. These WUGs are listed in Table 11.8. Any strategies associated with these new and removed WUGs are considered changes since the 2011 Plan. It is important to note that the changes to the WMSs listed in Table 11.7 are only changes to the base WMS. For example, if a WUG had a strategy in the 2011 Plan to purchase additional water from DWU and if in the 2016 Plan new infrastructure is required to purchase that water, that is not considered a change to the WMS because there was no change to the source of supply. Because conservation strategies were included for a large number of WUGs, changes to conservation strategies are discussed below and are not listed by WUG in Table 11.7.

The currently recommended Water Conservation Package for municipal WUGs (described in Section 5E.7.2) is generally consistent with the Basic Water Conservation Package recommended in the 2011 Plan, with the following changes:

- The 2011 "new efficient clothes washer standards" strategy from the 2011 Plan is now included in the water demand projections.
- The 2011 "water use reduction due to increasing prices" and "water conservation pricing structure" strategies have been combined to form the 2016 "price elasticity/rate structure impacts" strategy.
- Main replacement and automatic metering infrastructure have been added to the 2011 "water system audit, leak detection and repair, and pressure control" strategy to form the 2016 "enhanced water loss control program" strategy.

Some of the municipal water conservation strategies recommended in the Expanded Water Conservation Package in the 2011 Plan have limited applicability. Therefore, instead of renewing the recommendation an Expanded Water Conservation Package, the RCWPG recommends that WUGs be able to substitute any other appropriate, service-area specific water conservation strategies for those specifically listed in the Water Conservation Package. This recommendation is presented in greater detail in Section 5E.7.6. For non-municipal WUGs, the RCWPG has renewed the 2011 recommendation for manufacturing and irrigation rebate programs.

In addition to the information summarized in Table 11.7, detailed information regarding significant changes to WMSs for the Regional WWPs is provided below. The information below is intended to highlight the changes to several of the Regional WWP WMSs since the 2011 Plan, not to provide detailed information on the WMS itself. That information can be found in Sections 5B and 5C of this report.

Tehuacana. The Tehuacana Reservoir is a recommended strategy for the Tarrant Regional Water District (TRWD). Tehuacana Reservoir was an alternative strategy in the 2011 Region C Plan. Tehuacana Reservoir is a proposed reservoir on Tehuacana Creek in Freestone County, immediately south and adjacent to Richland-Chambers Reservoir.

Marvin Nichols Reservoir and Wright Patman Lake in the Sulphur River Basin. In the previous three Region C water plans, Marvin Nichols Reservoir was a recommended strategy. The reallocation of flood storage at Wright Patman Lake has been an alternative strategy in previous plans. In this plan, those projects continue to be strategies, but are now being considered as a combined recommended strategy (referred to as the Sulphur Basin Supplies strategy) and the elevations being considered are different than those previously considered. For the purpose of the 2016 Region C Water Plan, the Sulphur Basin Supplies Strategy assumes the reallocation of Wright Patman to 232.5 msl and new storage at Marvin Nichols site for a conservation pool elevation of 313.5. msl. In addition, the original configuration of Marvin Nichols Reservoir (at conservation pool elevation 328.0 msl) is also being retained as an alternative water management strategy for this 2016 Region C Water Plan. Detailed quantitative information on both the recommended Sulphur Basin Supplies strategy and the alternative Marvin Nichols (elevation 328.0) strategy is contained in Appendix P and Appendix Y.

In TWDB's January 8, 2015 Order [3] resolving the interregional conflict between the 2011 Region C and D Plans related to the Marvin Nichols Reservoir, TWDB encouraged both Region C and D to continue to participate in the ongoing Sulphur River Basin Studies. Region C entities have been and plan to continue participating in these ongoing studies. The Region C entities that are interested in development of Marvin Nichols Reservoir and other Sulphur Basin Supplies (NTMWD, TRWD, Dallas, UTRWD, and Irving) have formed a Joint Committee on Program Development (JCPD). Since 2001, the JCPD has provided more than $5 million to the Sulphur River Basin Authority (SRBA) to further investigate the development of Marvin Nichols Reservoir and other potential water supply sources in the Sulphur River Basin. Ongoing Sulphur Basin Feasibility studies are being conducted by the U.S. Army Corps of Engineers, SRBA and the JCPD. At the direction of SRBA and the JCPD, these ongoing studies are seeking to address concerns from Region D entities regarding the protection of natural resources, environmental impacts, and the socio-economic impacts of developing water supply within Region D and the Sulphur Basin. As a result, these ongoing studies have identified additional options for water supply in the Sulphur Basin that may address concerns from Region D and would also develop supply needed for Region C and Region D entities.

As identified in the 2014 Sulphur River Basin studies [(4)], this 2016 Region C Plan recommends a Marvin Nichols Reservoir that would be part of a combined strategy with the reallocation of flood storage to conservation storage in Wright Patman Lake. (This combination is referred to in this plan as the Sulphur Basin Supplies strategy). It should be recognized that the footprint of Marvin Nichols Reservoir being considered as part of this combination strategy is a smaller footprint than has previously been considered. The proposed combined Marvin Nichols and Wright Patman strategy would yield around 600,000 acre-feet per year (calculated using TCEQ WAM models, assuming Lake Ralph Hall is senior, and accounting for environmental flows). The Sulphur Basin Supplies strategy is a recommended water management strategy for NTMWD, UTRWD, and TRWD. It is also an alternative strategy for Dallas and the City of Irving. Approximately 80 percent of the water supplied from the Sulphur Basin Supplies strategy is expected to serve customers of wholesale water providers in Region C and approximately 20 percent would serve water needs in Region D.

Region C recognizes that there are inherent risks and impacts associated with the reallocation of flood storage at Wright Patman Lake. Reallocation of storage at Wright Patman Lake at the scale envisioned for the Sulphur Basin Supplies strategy will require recommendation by the Corps of Engineers/Department of the Army and approval by the United States Congress. Prior to making a recommendation, the Corps will need to conduct a detailed evaluation of impacts associated with raising the conservation pool elevation. Potentially significant impacts could include inundation of natural resources within the flood pool, loss of flood protection downstream, increased impacts to cultural resources on the reservoir perimeter, effects on the Congressionally-established White Oak Creek Mitigation Area in the upper reaches of the Wright Patman flood pool, and reduced flexibility in International Paper's effluent management operations downstream of the dam. Wright Patman reallocation may also be constrained by Dam Safety considerations. As more detailed studies seek to develop an understanding of the tradeoffs between the environmental impacts at Wright Patman in comparison with the predicted impacts of new storage at the Marvin Nichols site, the risk exists that the Wright Patman reallocation alternative may be constrained by either policy or environmental issues, or both. Recognizing these risks and impacts of the reallocation of Wright Patman, Region C is retaining the original configuration of Marvin Nichols Reservoir (as detailed in the *2011 Region C Water Plan*) as an alternative water management strategy for the 2016 Region C Water Plan. It is an alternative strategy for NTMWD, UTRWD, TRWD, and Irving.

Main Stem Trinity River Pump Station. This was a recommended strategy for Dallas Water Utilities (DWU) and North Texas Municipal Water District (NTMWD) in the 2011 Plan. It is recommended for both of these WWPs in the 2016 Plan, but the configuration of the strategy has changed. In the previous plan, the pump station was to be constructed by Dallas and utilized by both Dallas and NTMWD. Since the publication of that plan, NTMWD has started the design on the pump station and will construct the facility. There are still plans for both entities to make use of the facility.

Lake Columbia. Lake Columbia is a recommended strategy for DWU. This was an alternative strategy in the 2011 Region C Plan. Lake Columbia is a proposed reservoir project of the Angelina and Neches River Authority (ANRA). The reservoir would be connected to Dallas' water supply system via a pipeline from Lake Columbia to the proposed Integrated Pipeline pump station at Lake Palestine [(4)].

Neches Run-of-River. This was an alternative strategy in the 2011 Plan for DWU. Through an errata, it later became a recommended strategy in place of the Fastrill Replacement strategy. In the 2016 Plan, this is a recommended strategy for DWU. The strategy includes a new river intake and pump station for a run-of-river diversion from the Neches River. Water will be delivered to Dallas' pump station at Lake Palestine for delivery to Dallas through the Integrated Pipeline [(5)].

Removal of Silt Barrier at Lake Chapman Intake Pump Station. This is a new recommended strategy for North Texas Municipal Water District (NTMWD), Upper Trinity Regional Water District (UTRWD), and Irving. NTMWD is in the construction phase of a project that would remove a silt barrier in Chapman Lake. This silt barrier currently limits the amount of water reaching the intake structure at the lake. This project will allow for use of the full yield from Chapman Lake.

Dredge Lake Lavon. This is a new recommended strategy for NTMWD. NTMWD is in the design phase of a project that will remove sediment in Lake Lavon. This dredging project would allow NTWMD to divert water down to elevation 467 msl.

11.3.7 Total Cost of Recommended Strategies

Most of the new supplies for Region C will be developed by the major wholesale water providers in the region. The total cost of implementing all of the water management strategies in the 2016 Region C Plan is $23.5 billion. The total cost from the 2011 Region C Plan was $21 billion. The main changes related to the increase in the cost to develop all of the WMSs are due to changes to several of the large WMSs and inflation.

11.4 Conclusion

Since the 2011 Region C Water Plan there have been 30 WMSs implemented, over 200 WMSs no longer being considered by WUGs/WWPs (including 184 WMSs related to supplemental wells), and over 140 WMSs that are still included in the 2016 Plan, but are different from the way in which they were included in the 2011 Plan. The total 2060 demand for the region has decreased since the 2011 Plan from 3,272,461 acre-feet per year to 2,676,836 acre-feet per year. Since the 2011 Plan, the total available supplies have decreased by nearly 91,900 acre-feet per year. This is largely due to the lower availability from surface water due to the use of safe yields by some of the larger WWPs. However this is partially offset by greater availability from reuse due to the development of new reuse projects. The total need decreased by nearly 500,000 acre-feet per year in 2060 since the 2011 Plan.

Table 11.8
Changes to Water Management Strategies Since the 2011 Region C Water Plan

Sponsor	Project Name	Water Management Strategy Name	Change from 2011 Plan
Aledo	Additional water from Fort Worth (TRWD)	Additional water from Fort Worth (TRWD)	2011 Plan was for initial infrastructure to Fort Worth; 2016 Plan is for additional infrastructure
Alvord	Additional water from West Wise SUD		New recommended WMS; previous WMS was to connect to West Wise SUD
Anna	Grayson County Water Supply Project	Sherman WTP	New alternative WMS
Arlington	Additional water from TRWD	Raw Water Pump Station Improvements	New recommended WMS
Arlington	Additional water from TRWD	Raw water line extension at Pierce Burch WTP	New recommended WMS
Arlington	Additional water from TRWD	John F. Kubala WTP Expansion & Improvements	Now includes raw water supply line as well as expansion
Athens	New Wells		New recommended WMS
Aurora	Additional water from Rhome		New recommended WMS; previous WMS was to connect to Rhome
Balch Springs	Additional Dallas		New recommended WMS; previously was through DCWCID #6
Bardwell	Additional Rockett SUD		New recommended WMS
Benbrook	Plant Expansion	4.25 MGD WT Plant Expansion	2011 Plan had three 3 MGD expansions; 2016 plan has one 4.25 MGD plant expansion and a contract increase with TRWD
Blue Mound	Monarch Utilities	Purchase existing water system from Monarch Utilities	New recommended WMS
Blue Ridge	Upsize Connection and water from NTMWD		New recommended WMS
Bolivar WSC	Gainesville	Initial Connection and water from Gainesville	Part of the Cooke County WSP (now referred to as Gainesville) that was a recommended WMS in the 2011 Plan
Collin County Manufacturing	New Well in Woodbine Aquifer		New recommended WMS
Collin County Mining	Additional Water from NTMWD		No longer a recommended WMS
Cooke County Irrigation	Additional Gainesville		Part of the Cooke County WSP (now referred to as Gainesville) that was partially implemented since the 2011 Plan
Cooke County Manufacturing	Additional Gainesville		Part of the Cooke County WSP (now referred to as Gainesville) that was partially implemented since the 2011 Plan
Cooke County Mining	Connect to Gainesville		Part of the Cooke County WSP (now referred to as Gainesville)
Cooke County Other	Connect to Gainesville		New recommended WMS, Part of the Cooke County WSP (now referred to as Gainesville)
Cooke County Other	Connect to Gainesville System		Part of the Cooke County WSP (now referred to as Gainesville) that was a recommended WMS in the 2011 Plan
Corinth	New wells in Trinity Aquifer		New recommended WMS
Cresson	New well in Trinity Aquifer (Parker Co)		New recommended WMS
Dallas	Main Stem Pump Station		Now includes a balancing reservoir
Dallas	Direct reuse		Remaining amount to be implemented is now an alternative WMS
Dallas	Lake Columbia		Was an alternative WMS, now a recommended WMS
Dallas	Wright Patman		Was recommended, now alt WMS in combination with Marvin Nichols (referred to as the Sulphur Basin Strategy)
Dallas County Manufacturing	Additional water from Grand Prairie		New recommended WMS
Dallas County Other	Additional Water for DFW Airport	Additional water from DWU and Ft Worth/TRWD	New recommended WMS
Dallas County Other	Additional Water from DWU		New recommended WMS
Dallas County Steam Electric Power	Additional water from NTMWD		No longer a recommended WMS
Denison	WTP Expansion & more Texoma		Changes to the number and size of WTP expansions from the 2011 Plan
Denton	Water treatment plant expansions	Water treatment plant - expansion	Changes to the number and size of WTP expansions from the 2011 Plan

Sponsor	Project Name	Water Management Strategy Name	Change from 2011 Plan
Denton County Irrigation	Water Conservation		New recommended WMS
Denton County Manufacturing	Additional water from Northlake		New recommended WMS
Denton County Other	Additional water from Little Elm		New recommended WMS
East Cedar Creek FWSD	WTP expansion and TRWD		Changes to the number of WTP expansions from the 2011 Plan
Eustace	New well in Carrizo-Wilcox Aquifer		New recommended WMS
Fannin County Steam Electric Power	Additional water from Lake Texoma (GTUA)		New recommended WMS
Files Valley WSC	Ellis County WSP		Water is no longer through Buena-Vista Bethel WSC
Fort Worth	Eagle Mountain WTP Expansion		WMSs was changed from 70 mgd expansion to 30 mgd expansion
Freestone County Irrigation	Water Conservation		New recommended WMS
Fort Worth	Advanced Meter Infrastructure System	Conservation	New recommended WMS
Fort Worth	Water Conservation and Condition Assessment Program	Conservation	New recommended WMS
Freestone County Other	Additional water from Corsicana		New recommended WMS
Freestone County Other	Water from TRWD	New delivery and treatment facilities	New recommended WMS
Frost	Additional water from Corsicana		New recommended WMS
Gainesville	Additional raw water from Lake Moss	WTP Expansion and infrastructure	Changes to the number and size of WTP expansions from the 2011 Plan
Gastonia-Scurry SUD	Connect to Seagoville (DWU)		New recommended WMS
Grapevine	Purchase unused Lake Grapevine yield from DCPCMUD		New alternative WMS
Grapevine	Additional water from DWU		New recommended WMS
Grayson County Irrigation	Water Conservation		New recommended WMS
Grayson County Manufacturing	Direct reuse from Sherman		New alternative WMS
Grayson County Mining	New well in Trinity Aquifer (Red Basin)		New recommended WMS
Grayson County Steam Electric Power	Direct reuse from Sherman		New alternative WMS
Gunter	New well		New recommended WMS
Henderson County Mining	Additional water from TRWD		New recommended WMS
Henderson County Other	Additional water from TRWD		New recommended WMS
Howe	Grayson County Water Supply Project	Sherman WTP	New alternative WMS
Irving	Direct reuse		Project configuration has changed since 2011 Plan
Irving	Oklahoma water		Was recommended, now an alternative WMS
Irving	Marvin Nichols		Have added an alternative WMS of combined Marvin Nichols with Wright Patman reallocation of flood storage (referred to as Sulphur Basin Supplies)
Jack County Irrigation	Water Conservation		New recommended WMS
Jack County Mining	TRWD		New recommended WMS
Jack County Other	Walnut Creek SUD		New recommended WMS
Jack County Other	Connect to Jacksboro (Lost Creek/Jacksboro system)		New recommended WMS
Jack County Steam Electric Power	Additional TRWD		New recommended WMS
Jacksboro	Jacksboro indirect Reuse to mining		New recommended WMS
Justin	New Well		New recommended WMS
Kaufman County Irrigation	Additional water from TRWD		New recommended WMS
Kaufman County Mining	Trinity Aquifer new wells		New recommended WMS
Kaufman County Mining	Connect to and purchase water from NTMWD		New recommended WMS
Kaufman County Other	Additional water from DWU		New recommended WMS
Kaufman County Other	Water from TRWD	New delivery and treatment facilities	New recommended WMS
Kemp	Additional water from WCCMUD		New recommended WMS
Kennedale	Water from Arlington (TRWD)	Initial connection	New recommended WMS
Krum	Additional groundwater	new well	New recommended WMS

Sponsor	Project Name	Water Management Strategy Name	Change from 2011 Plan
Ladonia	Connect to UTRWD (Ralph Hall)	Connect to UTRWD and construct WTP	WTP portion is a new recommended WMS
Lake Cities MUA	Infrastructure to deliver to customers		New recommended WMS
Lake Kiowa SUD	Connect to Gainesville System		Part of the Cooke County WSP (now referred to as Gainesville). Formerly Kiowa Homeowners WSC
Leonard	Fannin County WSP (NTMWD)	Water system improvements	New recommended WMS
Lewisville	Additional DWU	WTP expansions	Changes to WTP expansions since 2011 Plan
Lindsay	Connect to Gainesville System		Part of the Cooke County WSP (now referred to as Gainesville)
Malakoff	Additional water from TRWD		New recommended WMS
Marilee SUD	Additional water from Sherman		2011 Plan showed purchase from the Grayson County Water Supply Project. Marilee purchases directly from Sherman
Melissa	Additional water from NTMWD (thru McKinney)		New recommended WMS
Midlothian	Additional TRWD supply	WTP expansions	Changes to the size of the WTP expansions
Muenster	Connect to Gainesville		New alternative WMS
Navarro County Irrigation	Water Conservation		New recommended WMS
Navarro County Steam Electric Power	Purchase water from TRWD		New recommended WMS
NTMWD	Removal of Chapman Silt Barrier		New recommended WMS
NTMWD	Dredge Lavon		New recommended WMS
NTMWD	Additional Measures to Access Full Lavon Yield		New recommended WMS
NTMWD	Freestone/Anderson County Groundwater (Forestar)		New recommended WMS
NTMWD	Marvin Nichols		Recommended WMS from 2011 Plan has changed from Stand-alone Marvin Nichols to a recommended WMS of Marvin Nichols combined with Wright Patman reallocation of flood storage (referred to as Sulphur Basin Supplies); Stand-alone Marvin Nichols was recommended WMS in 2011 Plan, now an alternative
Palmer	Additional water from Rockett SUD		New recommended WMS; previous WMS was to connect to Rockett SUD
Parker County Manufacturing	Additional water from Walnut Creek SUD/TRWD		New recommended WMS
Parker County Manufacturing	New wells in Trinity Aquifer		New recommended WMS
Parker County Other	Additional water from TRWD		New recommended WMS
Parker County Other	Additional water from Walnut Creek		New recommended WMS
Parker County Other	New WTP and water from BRA (Region G)		The entity this WMS is associated is now considered a WUG and this WMS is now associated with that WUG (Parker County SUD)
Pecan Hill	Additional Rockett SUD		New recommended WMS
Pottsboro	Additional Denison		Up to existing constraint limit
Rockett SUD	WTP expansions		Changes to the number and size of WTP expansions from the 2011 Plan
Rockett SUD	Additional Midlothian		New recommended WMS
Rockwall County Irrigation	Additional water from NTMWD		New recommended WMS
Sanger	Additional water from UTRWD		In 2011 Plan water was shown coming from Bolivar WSC rather than UTRWD
Sansom Park	Additional Fort Worth		New recommended WMS
Sardis-Lone Elm WSC	Connect to Midlothian		New recommended WMS
Sardis-Lone Elm WSC	Additional Rockett SUD		New recommended WMS; previous WMS was to connect to Rockett SUD
South Grayson WSC	Grayson County Water Supply Project		In 2011 Plan was from the Northwest WTP, now from the Sherman WTP
Southmayd	Grayson County Water Supply Project		In 2011 Plan was from the North WTP, now from the Sherman WTP
Southwest Fannin County SUD	New well in Woodbine Aquifer and transmission facilities		New recommended WMS
Tarrant County Mining	Additional water from TRWD		New recommended WMS
Tarrant County Other	Additional water from DWU		New recommended WMS
Tarrant County Other	Purchase water from Euless (for DFW Airport)		New alternative WMS
Tioga	Grayson County Water Supply Project	Northwest WTP	New alternative WMS
Trenton	New well in Woodbine Aquifer		New recommended WMS

Sponsor	Project Name	Water Management Strategy Name	Change from 2011 Plan
TRWD	Western Oklahoma		Now an alternative WMS, was recommended in 2011 Plan
TRWD	Toledo Bend		Now an alternative WMS, was recommended in 2011 Plan
TRWD	Tehuacana		Was an alternative WMS, now a recommended WMS
TRWD	Wright Patman		Was an alternative WMS, now a recommended WMS referred to as Sulphur Basin Supplies
TRWD	Marvin Nichols		Recommended WMS from 2011 Plan has changed from Stand-alone Marvin Nichols to a recommended WMS of Marvin Nichols combined with Wright Patman reallocation of flood storage (referred to as Sulphur Basin Supplies); Stand-alone Marvin Nichols was recommended WMS in 2011 Plan, now an alternative
TRWD	Interim Purchase from DWU		New recommended WMS
UTRWD	Oklahoma water		Moved from recommended to alternative WMS
UTRWD	Contract Negotiation with Commerce for Chapman		New recommended WMS
UTRWD	Contract Negotiation with Commerce for Chapman Reuse		New recommended WMS
UTRWD	Marvin Nichols		Recommended WMS from 2011 Plan has changed from Stand-alone Marvin Nichols to a recommended WMS of Marvin Nichols combined with Wright Patman reallocation of flood storage (referred to as Sulphur Basin Supplies); Stand-alone Marvin Nichols was recommended WMS in 2011 Plan, now an alternative
Valley View	Connect to Gainesville System		Part of the Cooke County WSP (now referred to as Gainesville)
Van Alstyne	Water system improvements		New recommended WMS
Venus	Additional water from Midlothian		New recommended WMS
Walnut Creek SUD	Additional TRWD water	New WTP	Changed from 2 MGD to 4.2 MGD capacity
Walnut Creek SUD	Additional TRWD water	WTP expansions	Changes to the size and number of expansions
Waxahachie	Additional TRA/TRWD water	WTP expansions	Changes to the number, sizes, and location of planned expansions
Weatherford	Indirect Reuse		New recommended WMS
West Cedar Creek MUD	Additional water from TRWD	WTP expansions	Changes to the size of the WTP expansions
Weston	New wells in Woodbine Aquifer		New recommended WMS
Whitesboro	Grayson County Water Supply Project	Sherman WTP	New alternative WMS
Willow Park	Fort Worth (TRWD)		Changed from recommended to alternative WMS
Wise County Irrigation	Additional water from TRWD	New contract	New recommended WMS
Wise County Manufacturing	New wells in Trinity Aquifer		New recommended WMS
Wise County Other	Additional water from TRWD		New recommended WMS
Woodbine WSC	Connect to Gainesville System		Part of the Cooke County WSP (now referred to as Gainesville)
Wortham	Additional supply from Mexia (Region G)		New recommended WMS

Table 11.9
New and Removed WUGs Since the 2011 Plan

New WUGs	Removed WUGs
Annetta North	Bartonville WSC
Copeville SUD	Combine WSC
Corbet WSC	Community Water Company
Denton Co FWSD #10	Danville WSC
Denton Co FWSD #7	Hebron
Garrett	Lincoln Park
Kentucky Town WSC	Milligan WSC
Lakewood Village	Paradise
Lavon	R-C-H WSC
Mountain Spring WSC	Sanctuary
Oakwood	
Paloma Creek	
Parker Co SUD	
Providence Village WCID	
Rose Hill SUD	
Seis Lagos	
Talty WSC	
Westlake	
Wylie Northeast SUD	

CHAPTER 11
LIST OF REFERENCES

(1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: 2011 Region C Water Plan, prepared for the Region C Water Planning Group, Fort Worth, October 2010.

(2) Texas Water Development Board, *Exhibit C First Amended General Guidelines for Regional Water Plan Development* (October 2012), Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2016/doc/current_docs/contract_docs/2012_exhC_1st_amended_gen_guidelines.pdf, January 28, 2013.

(3) Texas Water Development Board, *An Order Concerning the Interregional Conflict between the 2011 North Central Texas Regional Planning Area Regional Water Plan and the 2011 North East Texas Regional Planning Area Regional Water Plan in Accordance with Texas Water Code Section 16.053*, January 8, 2015.

(4) HDR Engineering, Inc. *Draft 2014 Dallas Long Range Water Supply Plan to 2070 and Beyond,* October 2014.