Agenda Item 5c-5e. Planning Process:

c. **Review and Discussion of Technical Memorandum**
d. **Accept Public Comment on Technical Memorandum**
e. **Consider Approval of the Technical Memorandum and Authorize Consultant to Work with TWDB to Make Changes as Needed to the Technical Memorandum**

As part of the TWDB schedule for regional water planning our consultant must submit a Technical Memorandum related to Scope of Work Task 4C by March 4, 2024. This agenda item is to review and discuss the Technical Memorandum. This memorandum is comprised of database reports on the region's Population Projection, Water Demands, Water Availability, Existing Water Supplies, Identified Water Needs, and Comparisons to the 2021 Regional Water Plan.

After review of the Technical Memorandum, the RWPG will receive public comment on the Technical Memorandum in accordance with TWDB rule and guidance. The public comment period will be open from January 18, 2024 until the date of the public RWPG meeting, February 1, 2024.

The RWPG will then consider approval the memorandum prior to submission to the Texas Water Development Board and consider authorizing the consultant to work with TWDB to make adjustments as needed.

Attachments:

1. Draft Region F Technical Memorandum

Innovative approaches
Practical results
Outstanding service

REGION F WATER PLANNING AREA

TECHNICAL MEMORANDUM

Prepared for:

Texas Water Development Board

On behalf of the Region F Water Planning Group

February 2024

Prepared by:

FREESE AND NICHOLS, INC.
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Fort Worth, Texas 76102
817-735-7300

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This Technical Memorandum discusses population and water demand projections, water availability, existing water supplies, and identified potentially feasible water management strategies in Region F for the sixth cycle of regional water plan development. Included in this report are the required Texas Water Development Board (TWDB) Database 2027 (DB27) reports along with the additional information required for the Technical Memorandum submittal as set forth in Section 2.12.1 of TWDB's *Second Amended Exhibit C (General Guidelines for the 2026 Regional Water Plans)* dated September 2023. A public meeting was held on February 1, 2024, to discuss the contents of this memorandum. Notice of the meeting was posted on January 17, 2024.

1.0 TWDB DB27 REPORTS

All DB27 reports are located in Appendix A of this document. The seven required DB27 reports for this Technical Memorandum are summarized below.

1.1 POPULATION AND WATER DEMAND PROJECTIONS

In 2022, TWDB released draft non-municipal demand projections for all regions. Draft population and municipal projections were provided to the regions in 2023. Two population migration scenarios were prepared for the draft projections and the regions' consideration. Each Regional Water Planning Group (RWPG) was given the ability to make limited adjustments to the projections based on available data to support the requested revisions. The Region F Regional Water Planning Group (RFWPG) met on May 18, 2023, and approved revisions to the draft irrigation, manufacturing, mining, and steam electric power water demands. The RFWPG did not recommend revisions to the draft livestock demands. Revisions were also approved by the RFWPG for the population and municipal demands on July 20, 2023. These revision requests were reviewed by TWDB staff and submitted, with some modifications, to the TWDB Board of Directors for final approval. TWDB approved the final projections in November 2023.

Appendix A contains two database reports related to population and demand. The reports are:

- **TWDB DB27 Report #1 - WUG Population Projections**
- **TWDB DB27 Report #2 - WUG Water Demand Projections**

TWDB DB27 Report #1 presents the projected populations for each municipal water user group. This includes water utilities or water systems that provide an average of more than 100 acre-feet per year to retail municipal customers, and rural/unincorporated areas of municipal water use, known as County Other. **TWDB DB27 Report #2** provides the projected water demands for each water user group. This includes both municipal and non-municipal demands. The data in Reports #1 and #2 are reported by entity, county, and river basin.

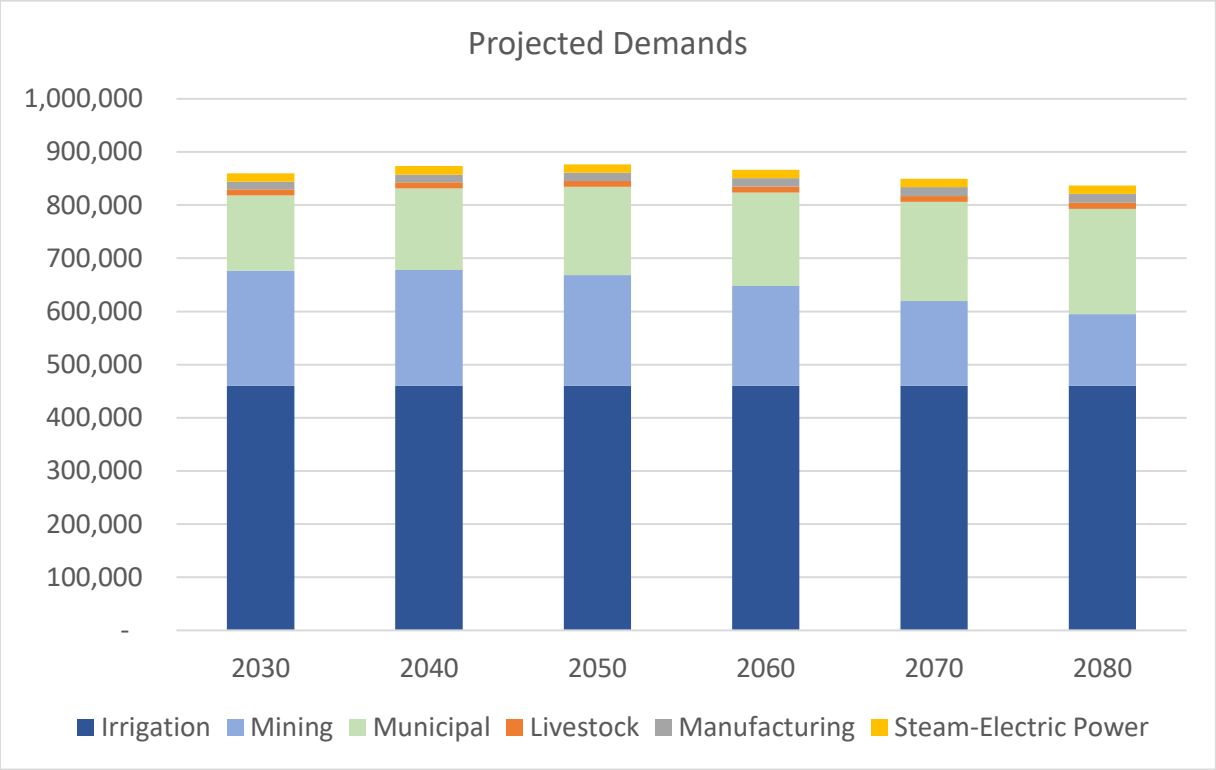
In additional to these summary tables, **Table 1-1** shows the population projections by county. The population for Region F is expected to increase from approximately 763,000 to 1,075,000 over the planning horizon. Most of the increase in population and municipal demands occur in Ector, Midland, and Tom Green Counties.

Table 1-1: Adopted Population Projections for Region F by County

County	2030	2040	2050	2060	2070	2080
ANDREWS	22,997	28,993	35,825	42,717	50,229	58,417
BORDEN	608	603	601	607	614	622
BROWN	39,717	40,383	40,459	40,599	40,752	40,919
COKE	3,454	3,690	3,932	4,317	4,737	5,195
COLEMAN	7,087	6,424	5,759	5,254	4,724	4,168
CONCHO	3,905	3,810	3,718	3,629	3,536	3,438
CRANE	5,027	5,493	5,887	6,205	6,552	6,930
CROCKETT	2,845	2,633	2,409	2,250	2,083	1,908
ECTOR	185,779	207,148	225,963	239,926	254,560	269,935
GLASSCOCK	1,049	985	946	869	788	703
HOWARD	36,259	37,313	37,885	37,115	36,276	35,361
IRION	1,429	1,357	1,332	1,279	1,223	1,164
KIMBLE	4,063	3,821	3,650	3,625	3,599	3,572
LOVING	64	64	64	64	64	64
MARTIN	5,543	5,896	6,311	6,530	6,769	7,030
MASON	3,821	3,708	3,666	3,661	3,656	3,651
MCCULLOCH	7,430	7,136	6,817	6,638	6,450	6,253
MENARD	1,767	1,637	1,524	1,496	1,467	1,437
MIDLAND	192,470	216,809	241,697	59,762	278,739	298,635
MITCHELL	10,837	11,020	11,250	11,361	11,474	11,594
PECOS	15,637	16,195	16,587	16,933	17,296	17,677
REAGAN	3,490	3,592	3,633	3,641	3,649	3,657
REEVES	16,015	17,702	19,284	20,384	21,583	22,890
RUNNELS	9,842	9,786	9,662	9,620	9,576	9,530
SCHLEICHER	2,107	1,806	1,522	1,291	1,049	795
SCURRY	17,450	18,006	18,344	18,517	18,699	18,890
STERLING	1,704	2,226	2,923	3,824	4,806	5,876
SUTTON	3,067	2,778	2,482	2,266	2,039	1,801
TOM GREEN	132,573	145,445	156,800	168,070	180,354	193,744
UPTON	3,349	3,475	3,550	3,627	3,708	3,793
WARD	12,954	14,666	16,450	18,013	19,717	21,574
WINKLER	8,646	9,744	10,757	11,653	12,630	13,695
TOTAL	**762,985**	**834,344**	**901,689**	**955,743**	**1,013,398**	**1,074,918**

Figure 1-1 is a graph of demands by use type and decade for Region F. Irrigation use accounts for over half of the demand in Region F. While municipal water demands are expected to increase over time, total water demands in Region F are expected to decrease slightly over time due to projected decreases in mining water use.

Figure 1-1: Total Water Demand Projections by Use Type and Decade in Acre-Feet per Year



1.2 SOURCE WATER AVAILABILITY

TWDB DB27 Report #3 – Source Water Availability presents the available water by source. Under the TWDB regional water planning guidelines, each region is to identify available water supplies within the region. 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 the permitted amount, whichever is lower. Region F has chosen to use safe yields, as opposed to firm yields, as the available supply. The safe yield is less than the firm yield and leaves a one-year supply reserve in storage at the end of the drought of record. For run-of-river supplies, the reliable supply is the minimum modeled annual diversion over the historical record. Available groundwater supplies are defined by county and aquifer. Through the Joint Planning Process, Modeled Available Groundwater (MAG) values were developed by the TWDB to define the long-term available groundwater supply for the major and

Region F. MAG values were not developed for aquifers or portions of aquifers that were declared "non-relevant" and other formations that are not modeled (such as "other aquifer" and Cross Timbers Aquifer).

Region F has nearly 1.3 million acre-feet per year of available water in 2030. This includes both developed and undeveloped supplies. Most of this supply is associated with groundwater sources. **Table 1-2** shows the overall water supply source availability in Region F. It should be noted that these supplies have not been limited by the current infrastructure that treats and delivers the water. The amount of supply available when considering infrastructure limitations is referred to as "Existing Water Supplies" and is discussed in Section 1.3 of this Technical Memorandum.

Table 1-2: Overall Water Supply Source Availability in the Region F (Acre-Feet per Year)

	2030	2040	2050	2060	2070	2080
GROUNDWATER	1,109,170	1,099,700	1,092,810	1,088,190	1,084,700	1,082,700
SURFACE WATER	131,070	130,110	127,530	123,330	118,080	113,320
REUSE	50,050	50,050	49,940	49,710	49,300	49,040
TOTAL	**1,290,290**	**1,279,860**	**1,270,280**	**1,261,230**	**1,252,080**	**1,245,060**

1.2.1 Surface Water

In regional planning, surface water supplies from reservoirs and run-of-river rights are derived from the Water Availability Models (WAMs) developed by the Texas Commission on Environmental Quality (TCEQ). The TWDB requires the use of Full Authorization Run (Run 3) of the approved TCEQ WAM for regional water planning. Full Authorization assumes that all water rights will be fully met in priority order. Under this analysis, many water rights in Region F show no availability (due to senior water rights in the lower basin). Because this does not give an accurate assessment of water supplies based on the way the basin has historically been operation, Region F considers subordination of the Lower Colorado basin (Region K) to the Upper Colorado basin (Region F) as a water management strategy. Water management strategies will be discussed as the next phase of regional planning and are not considered a current supply. Local supplies are surface water supplies that do not require a State water permit. These supplies are mainly stock tanks for livestock use and estimated based on historical use information from the TWDB.

Current surface water supplies (not constrained by infrastructure) in Region F are 131,070 acre-feet in 2030 and 113,320 acre-feet in 2080. The small decrease in these supplies over time is due to sedimentation in the region's reservoirs.

1.2.2 Groundwater

Groundwater supplies in the RFWPA are primarily obtained from the following major and minor aquifers:

- Ogallala Aquifer
- Edwards-Trinity (Plateau) Aquifer
- Pecos Valley Aquifer
- Trinity Aquifer
- Capitan Reef Complex Aquifer
- Dockum Aquifer
- Edwards-Trinity (High Plains) Aquifer
- Ellenburger – San Saba Aquifer
- Hickory Aquifer
- Marble Falls Aquifer
- Rustler Aquifer
- Cross Timbers Aquifer
- Igneous Aquifer
- Additional supplies in Region F are available from non-relevant portions of the major and minor aquifers, which also includes the Lipan, Igneous and Seymour Aquifers, and
- Locally undifferentiated formations, referred to as "Other Aquifer"

As required by regional planning rules, MAG estimates provided by the TWDB were used to determine groundwater availability. For Region F, TWDB provided MAG estimates for the named aquifers listed above and some of the non-MAG availability estimates for non-relevant portions of the listed aquifers. A comparison of MAG totals from the previous and current planning cycles indicate some decreases and some increases of groundwater availability. The largest decreases are in the Ogallala, Dockum, and Capitan Reef Aquifers. In GMA-7, the Edwards-Trinity (Plateau) and Pecos Valley Aquifers are lumped into one volume in the MAG estimate. The Ogallala and Edwards-Trinity (High Plains) are also combined.

Region F includes parts of Groundwater Management Areas (GMAs) 2, 3 7 and 8. The groundwater supplies available to Region F are summarized in **Table 1-3.** The total volume for planning purposes in Region F is based on the sum of MAGs and non-MAG estimates of groundwater availability. **Table 1-3** totals the groundwater supply availability estimates for MAGs, non-relevant aquifers and other aquifers.

Table 1-3. Total Groundwater Availability to Region F in Acre-Feet per Year

Source	2030	2040	2050	2060	2070	2080
Ogallala and Edwards-Trinity-High Plains Aquifers	87,747	79,640	73,912	70,101	67,427	65,421
Ogallala Aquifer	23,361	21,994	21,048	20,323	19,581	19,581
Edwards-Trinity-Plateau and Pecos Valley Aquifers	420,541	420,541	420,541	420,541	420,541	420,541
Edwards-Trinity-Plateau Aquifer	2,112	2,112	2,112	2,112	2,112	2,112
Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers	336,401	336,401	336,401	336,401	336,401	336,401
Pecos Valley Aquifer	150	150	150	150	150	150
Trinity Aquifer	1,427	1,427	1,427	1,427	1,427	1,427
Capitan Reef Complex Aquifer	27,552	27,552	27,552	27,552	27,552	27,552
Cross Timbers Aquifer	1,204	1,204	1,204	1,204	1,204	1,204
Dockum Aquifer	71,230	71,230	71,019	70,932	70,859	70,859
Ellenburger-San Saba Aquifer	8,562	8,562	8,562	8,562	8,562	8,562
Hickory Aquifer	41,018	41,018	41,018	41,018	41,018	41,018
Igneous Aquifer	380	380	380	380	380	380
Lipan Aquifer	48,646	48,646	48,646	48,646	48,646	48,646
Marble Falls Aquifer	275	275	275	275	275	275
Rustler Aquifer	10,630	10,630	10,630	10,630	10,630	10,630
Seymour Aquifer	10	10	10	10	10	10
Other Aquifer	27,926	27,926	27,926	27,926	27,926	27,926
TOTAL	**1,109,172**	**1,099,698**	**1,092,813**	**1,088,190**	**1,084,701**	**1,082,695**

1.3 EXISTING WATER SUPPLIES

Existing Water Supplies (sometimes referred to as “currently available supplies” or “connected supplies”) are supplies that are limited by water rights, groundwater permits, contracts, and facilities that are currently in place. The Existing Water Supplies are less than the overall supplies available to the region (Source Water Availability from Section 1.2) because the facilities needed to use some of the source water have not yet been developed. Common constraints limiting supplies include the hydrogeologic properties of the source aquifers, capacity of transmission systems, treatment plants, wells, and permit limits.

Table 1-4 shows the Existing Water Supplies in Region F by county. **TWDB DB27 Report #4 – WUG Existing Water Supplies** shows the supplies allocated to each water user group by source.

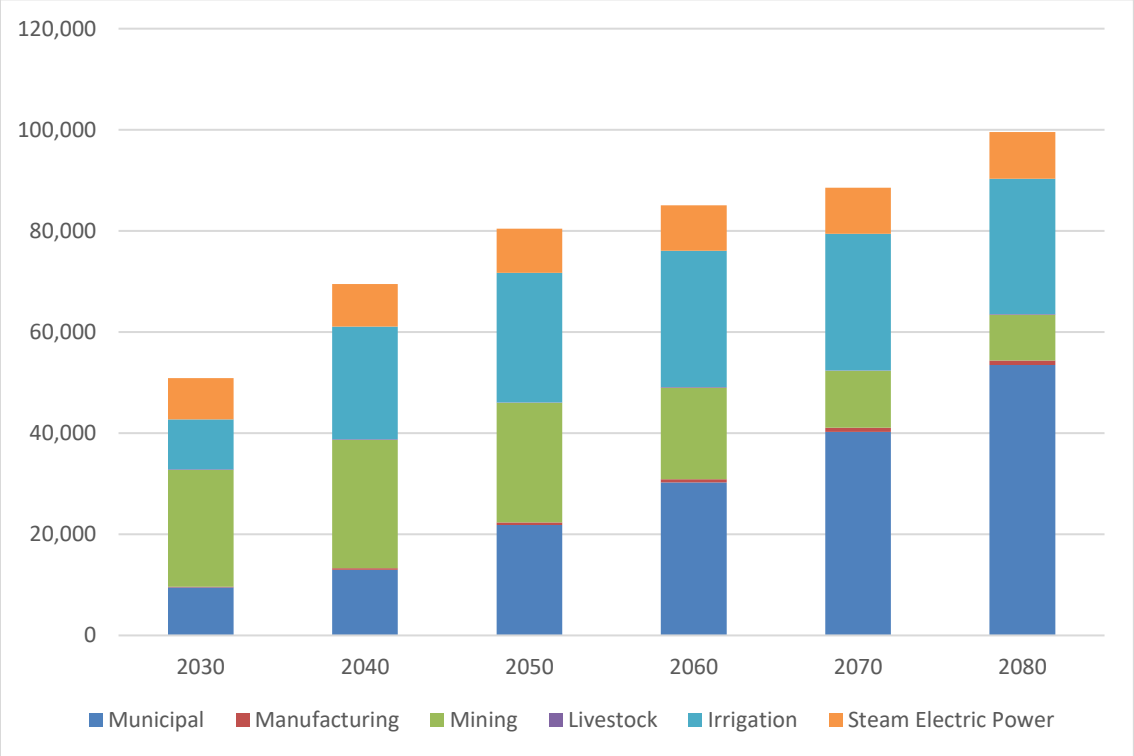
Table 1-4: Existing Water Supplies Available to Region F Water User Groups by County in Acre-Feet per Year

County	2030	2040	2050	2060	2070	2080
ANDREWS	19,825	18,635	17,924	17,518	17,324	17,186
BORDEN	5,874	5,882	5,848	5,586	4,821	4,137
BROWN	16,052	16,125	16,156	16,197	16,241	16,288
COKE	1,560	1,567	1,574	1,585	1,597	1,610
COLEMAN	1,517	1,476	1,440	1,414	1,392	1,369
CONCHO	6,214	6,206	6,185	6,158	6,131	6,105
CRANE	4,966	5,253	5,438	5,437	5,334	5,334
CROCKETT	5,459	5,459	5,459	5,459	4,608	3,361
ECTOR	40,701	41,899	40,893	39,014	37,995	37,019
GLASSCOCK	57,548	57,541	56,385	54,069	51,002	48,281
HOWARD	28,236	26,899	25,271	23,667	22,298	19,415
IRION	5,500	5,500	5,343	5,029	4,614	4,245
KIMBLE	1,881	1,856	1,839	1,837	1,833	1,827
LOVING	5,325	5,325	5,325	5,325	5,326	5,326
MARTIN	49,836	45,046	41,128	38,200	35,869	34,056
MASON	6,423	6,394	6,375	6,373	6,371	6,369
MCCULLOCH	4,927	4,916	4,906	4,894	4,876	4,854
MENARD	4,069	4,063	4,058	4,057	4,056	4,055
MIDLAND	85,077	85,430	83,938	79,912	75,250	70,649
MITCHELL	13,809	13,792	13,754	13,752	13,750	13,747
PECOS	159,999	160,104	160,212	160,421	160,655	160,910
REAGAN	42,446	42,467	40,825	37,523	33,147	29,268
REEVES	99,413	99,521	99,626	99,703	99,784	99,874
RUNNELS	4,834	4,808	4,748	4,691	4,653	4,614
SCHLEICHER	6,521	6,446	6,082	5,436	4,594	3,837
SCURRY	10,363	10,301	10,125	9,940	9,794	9,681
STERLING	2,986	3,128	3,307	3,425	3,425	3,038
SUTTON	2,737	2,633	2,529	2,451	2,368	2,282
TOM GREEN	70,449	65,778	65,688	65,518	65,343	65,174
UPTON	25,571	25,611	24,325	21,728	18,278	15,232
WARD	15,157	15,660	16,185	16,639	17,127	17,647
WINKLER	18,949	19,944	20,960	21,813	22,615	23,073
TOTAL	**824,224**	**815,665**	**803,851**	**784,771**	**762,471**	**739,863**

1.4 IDENTIFIED WATER NEEDS/SURPLUSES

For each Water User Group, the Existing Water Supply was compared to the projected demand, resulting in either a need or a surplus for the WUG. The total water needs for Region F increase from about 50,800 acre-feet in 2030 to nearly 100,000 acre-feet in 2080. This is largely driven by anticipated population growth and the resulting municipal water demand. Irrigation needs also grow as available groundwater supplies reduce over time. Mining needs shrink considerably over the planning cycle as demands are anticipated to decrease in later decades. Needs for other use types are relatively constant over the planning horizon. The water supply needs (no surpluses) that are unmet by existing water supplies are outlined below in **Figure 1-2** by category of use. **TWDB DB27 Report #5 – WUG Identified Water Needs/Surpluses** is a compilation of this information for all WUGs.

Figure 1-2: Water Supply Needs by Use Type and Decade in Acre-Feet per Year



1.5 COMPARISON TO 2021 REGIONAL WATER PLAN

Using its online databases (DB22 and DB27), TWDB has developed comparisons of information from this 2026 Regional Water Plan to information from the 2021 Regional Water Plan. The comparisons have been done for each Water User Group and for each supply source type by county, which are contained in **TWDB**

DB27 Report #7 – WUG Data Comparison to 2021 RWP and **TWDB DB27 Report #8 – Source Data Comparison to 2021 RWP**. Both reports are included in **Appendix A**.

In Region F, total source availability (before allocation to users) decreased slightly from the 2021 to 2026 plan primarily due to decreases in surface water availability. Groundwater availability declined slightly in 2030 due to changes in MAGs and updated non-MAG availability. Reuse availability stayed about the same. Surface water declines are the greatest in the Rio Grande River Basin in part due to an updated Water Availability Model.

Projected demands in Region F increased between 10 and 14 percent over the planning horizon from the 2021 to 2026 plan. This is mostly due to increases in population projections, which were based on the 2020 Census. Existing supplies to water user groups increased slightly and overall water needs decreased by 29 percent in 2030 and 14 percent in 2080.

2.0 DETERMINING SOURCE AVAILABILITY

2.1 SURFACE WATER

2.1.1 Reservoir Sedimentation Rates

For all major reservoirs in the Colorado and Rio Grande River Basins, anticipated sedimentation rates and revised area-capacity rating curves were developed to estimate reservoir storage in future decades (2030 and 2080). Annual sedimentation rates, expressed in acre-feet per square mile (AF/SqMi), were estimated for each major reservoir based on sediment surveys, published sedimentation rates, or comparing changes in conservation pool capacity between two or more reservoir surveys. The total accumulated sediment for a specific year was calculated as:

Sedimentation Rate X Drainage Area X Number of years from the Initial Survey

This formula was used to estimate the reservoir capacity for decades 2030 and 2080. The total sediment quantity is applied to the initial area-capacity-elevation (ACE) curve using either a conical or trapezoidal shape method (depending upon the best fit for the reservoir). To develop the new ACE, reservoirs were sliced into incremental storage volumes based on elevation, then a uniform reduction was applied to the horizontal surface area of each slice. New storage volumes were calculated for each increment and added together to calculate the total storage at each elevation. A summary of the sedimentation analyses and projected conservation capacities for the reservoirs in Region F is shown in Table 2-1.

Table 2-1: Estimated Sedimentation Rates and Projected Capacities

Reservoir	Drainage Area (SqMi)	Annual Sediment Rate (AF/SqMi)	Date of Initial Capacity	Conservation Capacity (acre-feet)			Source (sediment rate)
				Initial	2030	2080	
Colorado River Basin							
Thomas	934	0.11	9/1/1999	200,604	198,460	192,295	TDWR Report 268, 1982
Champion	186	0.51	1959	42,492	36,056	33,178	Previous FNI Studies
Colorado City	387	0.38	1964	31,967	20,733	13,373	Previous FNI Studies
Spence	1,954	0.13	7/1/1999	517,272	509,387	499,227	TDWR Report 268, 1982
Oak Creek	238	0.50	5/12/1953	39,360	30,176	25,416	TBWE Bulletin 5912, 1959
Ballinger (Moonen)	24	0.17	7/1/1985	6,050	5,866	5,703	Previous FNI Studies
Elm Creek (Winters)	64	0.17	9/24/2013	7,779	7,594	7,154	TWDB, 2014B
Twin Buttes	2,813	0.09	12/1/1962	186,200	169,081	158,954	TBWE Bulletin 5912, 1959
Nasworthy	107	0.16	9/15/1993	10,108	9,477	8,793	TDWR Report 268, 1982
O.C. Fisher	1,383	0.23	9/1/1962	115,743	94,155	81,431	Previous FNI Studies
O.H. Ivie	2791.5	0.68	3/15/1990	554340	477,777	401,848	TBWE Bulletin 5912, 1959
Mountain Creek	30.3	0	N/A	950	950	950	None
Brady Creek	523	0.08	5/15/1963	30,430	27,620	25,946	TDWR Report 268, 1982
Hords Creek	48	0.36	4/7/1948	8640	7,218	6,527	TDWR Report 268, 1982
Coleman	292	0.16	8/1/2006	38,094	36,978	35,072	TWDB, 2007
Clyde	39.7	0	N/A	5494	5494	5494	None
Brownwood	1,181	0.11	6/14/2013	136,350	134,112	128,872	TWDB, 2014A
Junction	932	0	N/A	300	300	300	None
Rio Grande River Basin							
Red Bluff	N/A	98[2]	1986	289,667	285,355	280,455	TWDB, 2013
Balmorhea	N/A	N/A	N/A	7,400	7,400	7,400	WAM Run 3

1. Sedimentation was not considered for Mountain Creek, Junction, Clyde, and Balmorhea reservoirs.
2. Sediment is estimated as a total annual rate rather than per square mile of drainage area.

2.1.2 Hydrologic Models

Surface water supplies in Region F are obtained mostly from the Colorado River Basin and the Pecos River Basin, which is a tributary of the Rio Grande River Basin. A small amount of Region F lies in the Brazos River Basin but there is little to no surface water supplied to Region F from this basin. In accordance with

TWDB rules, Region F used the Full Authorization (Run 3) of the TCEQ-approved WAMS to determine surface water availability. In Region F, many reservoirs and run-of-river water rights show no availability under a strict priority analysis like TCEQ WAM Run 3. Subordination of downstream water rights in Region K is major a source of supply for Region F but is considered a strategy and is not included in existing supplies in Technical Memorandum. Region F requested hydrologic variances, mainly the use of safe yield to more accurately reflect some of the other current conditions and operations in the region. This request is detailed in **Appendix B**.

2.1.3 Versions and Dates of Hydrologic Models

TCEQ-approved Water Availability Models (WAM) were used to determine the surface water availability for Region F. The version date and run type for each model is reported in **Table 2-1**. The respective input and output files are provided electronically with this Technical Memorandum.

Table 2-2: Hydrologic Models Used in Determining Surface Water Availability

Hydrologic Model	Version Date	Run Used	Comments
Colorado WAM	10-1-2023	Run 3	Current and 2080 Firm and Safe Yield
Rio Grande WAM	10-1-2023	Run 3	Current and 2080 Firm and Safe Yield
Brazos WAM	See Region G Tech Memo	Run 3	Used to determine run-of-river supplies

As required by the TWDB, modifications to the TCEQ-approved WAMs must be approved through a hydrologic variance request. Region F approved and submitted hydrologic variance requests for both the Colorado River and Rio Grande River WAMs on July 20, 2023. The Brazos River WAM, as modified by the Brazos G planning group, was used for Brazos River water supplies in Region F. The TWDB approved the hydrologic variance requests in a letter dated November 28, 2023. The surface water availability analysis are described in **Appendix B**, which contains the hydrologic variances request and the TWDB approval letter. The analyses of surface water availability were carried out by Freese and Nichols, Inc. for the Colorado and Rio Grande River Basins, and by the Brazos G consultant. for the Brazos River Basin.

Table 2-2 presents the firm and safe yields for major reservoirs in Region F.

Table 2-3: Estimated Firm and Safe Yields for Major Reservoirs in Region F

Scenario	2020	2030	2040	2050	2060	2070
Lake Ivie						
Firm Yield (ac-ft/yr)	33,600	32,740	31,880	31,020	30,160	29,300
Safe Yield (ac-ft/yr)	28,540	27,740	26,940	26,140	25,340	24,540
Lake Brownwood						
Firm Yield (ac-ft/yr)	19,000	18,860	18,720	18,580	18,440	18,300
Safe Yield (ac-ft/yr)	15,550	15,420	15,290	15,160	15,030	14,900
Lake Balmorhea						
Firm Yield (ac-ft/yr)	19,600	19,600	19,600	19,600	19,600	19,600
Red Bluff Reservoir						
Firm Yield (ac-ft/yr)	20,350	20,314	20,278	20,242	20,206	20,170
Safe Yield (ac-ft/yr)	16,180	16,152	16,124	16,096	16,068	16,040

2.2 GROUNDWATER

2.2.1 Written Summary of Modeled Available Groundwater (MAGs)

The MAGs for this planning cycle came from four GAM run documents as follows (see Table 2-4):

- GAM RUN 21-008 Addendum, which summarizes the MAG volumes for all aquifers within GMA-2,
- GAM RUN 21-009, which summarizes the MAG volumes for all aquifers in GMA-3,
- GAM RUN 21-012 which summarizes the MAG volumes for all aquifers in GMA-7, and
- GAM RUN 21-013, which summarizes the MAG volumes for all aquifers in GMA-8.

Table 2-4: GAM Models Used in Determining Groundwater Availability

GAM Version	Date Results Published	Model Used	GMA
GR 21-008 Addendum	June 3, 2022	High Plains Aquifer System GAM	GMA-2[1]
GR 21-009	January 11, 2022	Eastern Arm of the Capitan Reef Complex Aquifer GAM, Alternative one-layer Edwards-Trinity (Plateau) and Pecos Valley model, High Plains Aquifer System GAM, Rustler Aquifer GAM	GMA-3
GR 21-012	August 12, 2022	Capitan Reef Complex Aquifer GAM, High Plains Aquifer System GAM, Llano Uplift Aquifer System GAM, Rustler Aquifer GAM, Alternative one-layer Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifer model, Kinney County GCD model of the Edwards-Trinity (Plateau),	GMA-7
GR 21-013	November 1, 2022	North Trinity Woodbine GAM	GMA-8[2]

1. Only Andrews, Borden, Howard, and Martin Counties within Region F are in GMA 2.
2. Brown is the only county within Region F in GMA 8.

GR 21-008 Addendum summarizes MAGs for the Ogallala, Edwards-Trinity (High Plains), and the Dockum Aquifers using the High Plains Aquifer System (HPAS) GAM. In GMA-2, the Ogallala and Edwards-Trinity (High Plains) availability volumes were lumped together and range from 111,108 acre-feet per year in 2030 to 85,002 acre-feet per year in 2080 for Andrews, Borden, Howard and Martin Counties only. The MAG estimate for the Dockum Aquifer for Andrews, Borden, Howard and Martin Counties is 11,449 acre-feet per year for the 50-year planning cycle.

GR 21-009 summarizes MAGs for the Capitan Reef Complex, Dockum, Edwards-Trinity (Plateau), Pecos Valley and Rustler Aquifers. The Edwards-Trinity (Plateau) and the Pecos Valley Aquifers MAGs total 420, 541 acre-feet per year in GMA-3 for the 50-year planning cycle. The Capitan, Dockum, and Rustler Aquifer MAG estimates are 377, 11,142, and 2,587 acre-feet per year, respectively.

GR 21-012 estimates MAGs for the portions of the Capitan Reef Complex, Dockum, Edwards-Trinity (Plateau), Ellenburger-San Saba, Hickory, Ogallala, Pecos Valley, Rustler and Trinity Aquifers that are located within GMA-7 and determined to be relevant for planning. Total MAG estimates for GMA-7 range between 431,474 in 2030 and 430,371 acre-feet per year in 2080. Note that some of this total is a combination of MAGs from both GMA 3 and GMA 7.

GR 21-013 summarizes MAG volumes for all aquifers within GMA-8, including the Trinity, Ellenburger-San Saba, Hickory, and Marble Falls aquifers. The total MAG estimates for Brown County are 1,595 acre-feet per year for the 50-year planning cycle.

Table 2-5 summarizes the MAG volumes from these GAM runs for each aquifer.

Table 2-5. Modeled Available Groundwater Supplies for Region F in Acre-Feet per Year

Source	2030	2040	2050	2060	2070	2080
Ogallala and Edwards-Trinity-High Plains Aquifers	87,747	79,640	73,912	70,101	67,427	65,421
Ogallala Aquifer	7,673	7,372	7,058	6,803	6,570	6,570
Edwards-Trinity-Plateau and Pecos Valley Aquifers	420,541	420,541	420,541	420,541	420,541	420,541
Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers	332,527	332,527	332,527	332,527	332,527	332,527
Trinity Aquifer	1,427	1,427	1,427	1,427	1,427	1,427
Capitan Reef Complex Aquifer	26,545	26,545	26,545	26,545	26,545	26,545
Dockum Aquifer	41,110	41,110	41,110	41,110	41,110	41,110
Ellenburger-San Saba Aquifer	8,562	8,562	8,562	8,562	8,562	8,562
Hickory Aquifer	40,518	40,518	40,518	40,518	40,518	40,518
Marble Falls Aquifer	25	25	25	25	25	25
Rustler Aquifer	9,630	9,630	9,630	9,630	9,630	9,630
TOTAL	**976,305**	**967,897**	**961,855**	**957,789**	**954,882**	**952,876**

2.2.2 Documented Methodologies Utilized for Non-MAGs Availabilities

The total estimated groundwater availability for non-MAG aquifers or portions of aquifers ranges from 132,867 acre-feet per year in 2030 to 129,819 acre-feet per year in 2080. The availability volumes and methodologies used to derive these estimates are tabulated in Appendix C.

3.0 POTENTIALLY FEASIBLE WATER MANAGEMENT STRATEGIES

3.1 PROCESS FOR IDENTIFYING POTENTIALLY FEASIBLE WMS

The process for identifying potentially feasible water management strategies was presented at the October 19, 2023 RFWPG meeting in Big Spring. There were no public comments and the RFWPG approved the methodology. A description of the methodology is presented in **Appendix D**.

3.2 LIST OF POTENTIALLY FEASIBLE WMS

A list of potentially feasible water management strategies is included in **Appendix E**. These strategies are based on preliminary discussions with wholesale water providers, water user survey responses, and recommendations from the 2021 regional water plan. During analysis and development of the regional water plan, other strategies may be identified and included in this list. The types of strategies considered include:

- Conservation (municipal and irrigation)
- Purchase water from a provider (Voluntary Transfer)
- Develop new or additional groundwater
- Water treatment
- Direct potable reuse
- Indirect potable reuse
- Direct non-potable reuse
- Brush control
- Weather modification
- Conjunctive Use (may be combined with other strategy types)
- Aquifer, storage and recovery (may be combined with other strategy types)

4.0 INTERREGIONAL COORDINATION

Region F is centered in west central Texas and borders five regions: Regions E, G, J, K and O. There are areas of mutual interest warranting interregional coordination with each of these regions. For example, there are shared water supplies, split water user groups, and the need for compatible approaches to surface water supplies. These topics are discussed and coordinated between the regions and their consultants through interregional coordination memoranda and meetings, as needed. In addition, there are several similarities in the approaches and water concerns of these regions. To foster coordination with the adjoining regions, the RFWPG has assigned liaisons to the adjoining region. The liaisons attend the assigned region's planning group meeting and provide updates to the entire group. In turn, assigned liaisons from the adjoining regions to Region F have attended Region F meetings and provided updates to the region.

5.0 INFEASIBLE WATER MANAGEMENT STRATEGY ASSESSMENT

The Texas legislature passed a new requirement for the 2026 planning cycle that requires the RWPGs to review strategies and projects that require construction or a permit for potential infeasibility. Infeasible Water Management Strategies (WMS)s are defined as "WMSs where proposed sponsors have not taken an affirmative vote or other action to make expenditures necessary to construct or file applications for permits required in connection with implementation of the WMS on a schedule in order for the WMS to be completed by the time the WMS is needed to address drought in the plan." Any strategy determined to be infeasible must be removed from the plan.

At a minimum, RWPGs must review the status of strategies and projects with an online decade of 2020 in the 2021 plans. Additional near-term strategies and projects that have lengthy permitting or construction process should also be reviewed for infeasibility.

For a strategy to be considered feasible, one or more of the following criteria must be met:

1) If the WMS is recommended in 2020, it must be online by January 5, 2023.
2) If the WMS is in the correct planning decade but not yet online, affirmative steps must be taken towards implementation. These steps may include but are not limited to:
    a. Spending money on the strategy or project,
    b. Voting to spend money on the strategy or project,
    c. Applying for a federal or state permit for the strategy or project.

The Texas Water Development Board identified 155 strategies for review by the Region F planning group. Of these, 135 were conservation related and therefore do not require a permit or construction and were found to be feasible. An additional five strategies were for county-aggregated water user groups that represent a conglomeration of private entities such as manufacturing or mining. In these instances, the TWDB recognizes that without a distinct identifiable sponsor, information is not available to assess the feasibility of these projects and they can be considered feasible for this analysis. The Region F consultant reached out the remaining 15 project sponsors to determine the feasibility of the water management strategy/project. Of these, 11 were found to have taken affirmative action to implement the project in the plan and were found feasible. Four strategies with an online date of 2020 in the 2021 plan were found to be infeasible and will require an amendment to the 2021 Region F Plan. These include:

1. **City of Junction: Develop Additional Edwards-Trinity Plateau Aquifer Supplies**

   Based on discussions with the City of Junction, Junction has not yet taken affirmative action to implement this project but does plan to do so in the future. Region F consultant proposes to amend the 2021 Region F plan to move the online decade for this strategy from 2020 to 2030. This will create an unmet municipal need of about 200 acre-feet in 2020. The amendment will include justification in accordance with 31 TAC 357.50 (j).

2. **City of Balmorhea: Develop Edwards-Trinity-Plateau Aquifer Supplies**

   Based on discussions with City of Balmorhea, no affirmative action to implement this project has been taken yet. However, the City does understand the need to secure new water supplies in the future. Region F consultant proposes to amend the 2021 Region F plan to move the online decade for this strategy from 2020 to 2030. This will create an unmet municipal need of about 100 acre-feet in 2020. The amendment will include justification in accordance with 31 TAC 357.50 (j).

3. **City of Bronte: Develop Other Aquifer Supplies in Southwest Coke County**

   Based on discussions with City of Bronte, the City is moving forward with studies on groundwater supplies from Nolan County instead of Coke County. This was identified in the 2021 Plan as an alternative water management strategy. Region F consultant proposes to amend the 2021 plan to substitute the alternative water management strategy as the recommended strategy for Bronte.

4. **Mitchell County Steam Electric Power (SEP): Direct Non-Potable Sales from Colorado City**

   This project was for demands for a new FGE facility in Mitchell County. This strategy would provide non-potable reuse supplies from Colorado City to Mitchell County SEP (FGE). However, the FGE facility has never been built and the demands have not yet materialized. Because of this, no affirmative action has been taken to implement the project from the 2021 Region F Plan. The Region F consultant proposes to amend the 2021 plan to remove the strategy from the plan. This will increase an existing unmet need in Mitchell County for Steam Electric Power by 500 acre-feet. It should be noted that this need may or may not ever come to fruition. If the FGE facility was developed, this strategy could be reconsidered as a feasible alternative for a portion of the water supply needed.

Appendix F contains the analyses of the strategies identified by the TWDB for the infeasible strategy review. The conservation strategies are not included.

6.0 PUBLIC COMMENT

Public comments were accepted 14 days prior to and at the public meeting on February 1, 2024, when this Technical Memorandum was presented.

7.0 REFERENCES

Texas Board of Water Engineers (TBWE, 1959), Bulletin 5912, *Inventory and Use of Sedimentation Data in Texas*, prepared by the Soil Conservation Service for the TBWE, January 1959.

Texas Department of Water Resources (TDWR, 1982), Report 268, *Erosion and Sedimentation by Water in Texas*, prepared by John H. Greiner, U.S. Soil Conservation Services, February 1982.

Texas Water Development Board (TWDB, 2007), *Volumetric Survey of Lake Coleman, July-August 2006 Survey*, April 2007.

Texas Water Development Board (TWDB, 2013), *Volumetric Survey of Red Bluff Reservoir, November 2011 Survey*, February 2013.

Texas Water Development Board (TWDB, 2014A), *Volumetric and Sedimentation Survey of Lake Brownwood, June 2013 Survey*, May 2014.

Texas Water Development Board (TWDB, 2014B), *Volumetric and Sedimentation Survey of Lake Winters and Elm Creek Reservoir, September and October 2013 Surveys*, May 2014.