5E COUNTY WATER MANAGEMENT PLANS

There are 32 counties in Region F, of which eleven show no shortages after conservation and subordination. Twenty-one of the 32 counties in Region F were identified with a water shortage over the planning horizon. This subchapter discusses the water issues of each county and outlines the proposed water management strategies to meet these identified shortages. For some counties, there are projected shortages that cannot be met through an economically viable project. It is important to remember that economic viability of a project is based on the current understanding of the value of water and that maximum cost that can be paid for water in certain industries such as irrigated agriculture. These assumptions of economic viability may change over time and will be reevaluated in the next plan. These "unmet needs" are also identified, if present, by county. Descriptions of water management strategies that are developed by a major water provider are discussed in Chapter 5D and included in the county summary tables for completeness, as appropriate. Detailed evaluations of the potentially feasible water management strategies are included in Appendix C and the detailed costs are presented in Appendix D. A summary evaluation matrix is included in Appendix E.

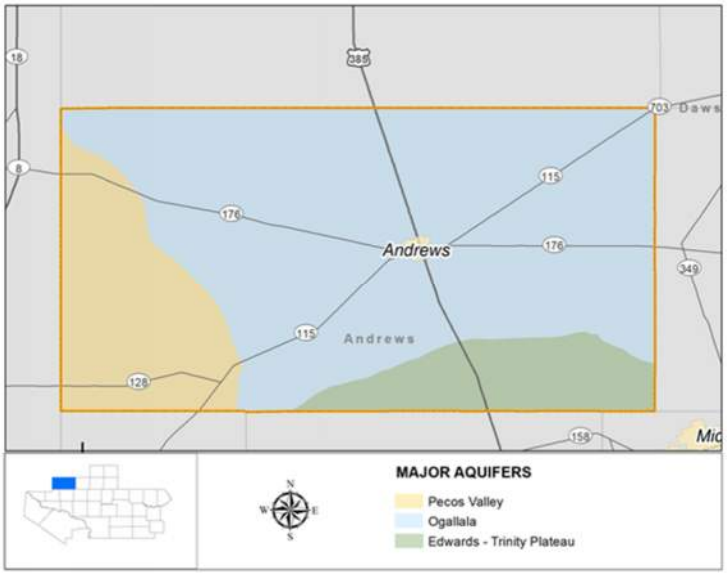
Region F Counties

- 32 total counties in the region
- 11 counties have no shortages after subordination and conservation
- 21 counties have shortages over the planning horizon
- 8 counties have unmet needs over the planning horizon

5E.1 Andrews County

Andrews County has limited surface water and groundwater supplies. Some local surface water is used by livestock, but the majority of water within Andrews County is supplied from the Dockum and Ogallala aquifers. Much of the supply from these sources is nearly fully developed for current use. As a result, there are identified shortages that may not be able to be met by supplies within the county.

The majority of Andrews County's shortages are associated with irrigation, municipal, and mining water needs. Irrigation is the largest water user group within Andrews County, with a water demand at approximately 20,365 acre-feet and current supplies available to meet this need of approximately 18,666 acre-feet in 2020. The only strategy identified for irrigation is conservation. The mining demand in Andrews County is 2,657 acre-feet in 2020, which cannot be met with existing supplies. Strategies identified for mining include utilizing recycled water (conservation) or non-potable reuse. Conservation strategies are discussed in more detail in Chapter 5B.



Most of the municipal shortage within Andrews County is affiliated with the City of Andrews, which has the second largest shortage identified within the county. The City obtains their water from the Ogallala aquifer and plans on expanding their well fields in order to better support their existing supply. Similarly, the Texland Great Plains Water Supply Company (Great Plains), a wholesale water provider (WWP) that operates in Andrews County and Gaines County (Region O), is also identified to have a need and plans to expand their well field. Most strategies for WUGs that have needs in Andrews County are to develop additional groundwater supplies, however, the current MAG volume available in the local aquifers will not support these desired projects. For planning purposes, if a strategy exceeds the MAG availability it does not qualify for state funding and cannot be a recommended strategy, whether or not a GCD is in place. For the purpose of this plan, groundwater strategies developed for water users in Andrews County are not recommended, but are alternative strategies put in place to be recommended only if the DFC and associated MAG were to change in future planning cycles.

5E.1.1 Andrews

Andrews Recommended Strategies

- Municipal Conservation
- Groundwater development strategies for Andrews are considered Alternative due to MAG limitations.

The City of Andrews obtains its water from city well fields in the Ogallala aquifer and purchased groundwater from University Lands. The City's contract with University Lands expires in 2035. It is assumed that the City will renew this contract for supplies through the planning period. Strategies to develop additional groundwater in the Ogallala aquifer as part of the City's well field expansion project exceed the current MAG availability, and therefore, these strategies are not recommended. However, they can be included as alternative strategies designed to be recommended upon a change in DFC and MAG availabilities in future planning cycles. More information pertaining to these projects are located in Appendix B. For the purpose of this plan, municipal conservation is expected to yield approximately 45 acre-feet in 2020. The preservation of existing supplies through municipal conservation is a recommended strategy.

The City of Andrews has also discussed the possibility of importing additional water from Val Verde County and from the T-Bar well field. However, the small amount of water obtained from these strategies does not seem to outweigh the considerable costs involved in the necessary infrastructure. These strategies were identified as not being potentially feasible and therefore were not fully evaluated as part of this planning cycle. If part of the infrastructure cost can be shared with others, these strategies may be more feasible in the future.

Potentially Feasible Water Management Strategies Considered for the City of Andrews:

- Municipal Conservation
- Develop Ogallala Aquifer Supplies
- Develop Edwards-Trinity Plateau Aquifer Supplies (Antlers Formation)

Alternative Water Management Strategies for the City of Andrews:

- Develop Ogallala Aquifer Supplies
- Develop Edwards-Trinity Plateau-Aquifer Supplies (Antlers Formation)

Develop Ogallala Aquifer Supplies

This strategy proposes additional groundwater development from the Ogallala Aquifer. A total of 14 new wells would be drilled along with associated well field piping. The amount of supply expected is 2,810 acre-feet per year, but there is no water available under the current MAG, causing this strategy to officially be listed as an Alternative strategy. However, there is currently no GCD in Andrews county to manage to the DFC and it is anticipated that users in Andrews County will continue groundwater development and use. Capital costs are estimated at $15.6 million.

Develop Edwards-Trinity Plateau Aquifer Supplies (Antlers Formation)

This strategy assumes that 38 new wells will need to be constructed at a 150-ft depth in order to access the additional aquifer supplies needed. Each well is assumed to be operating at a capacity of 50 gpm. A transmission pipe will be constructed to transfer the groundwater. This strategy will cost approximately $24.9 million to implement and is estimated to yield an additional 2,600 acre-feet of water per year.

Table 5E- 1
Recommended Water Strategies for Andrews

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		4,202	5,046	5,805	6,712	7,787	9,041
Existing Supply (Groundwater)		4,010	4,630	5,090	5,415	5,808	6,241
Shortage		192	416	715	1,297	1,979	2,800
Recommended Strategies							
Municipal Conservation	$0	45	55	96	111	129	150
Alternative Strategies							
Develop Ogallala & Edwards-Trinity-High Plains Aquifer Supplies	$15,663,000	2,810	2,810	2,810	2,810	2,810	2,810
Develop Edwards-Trinity Plateau Aquifer Supplies (Antlers Formation)	$24,927,000	2,600	2,600	2,600	2,600	2,600	2,600

5E.1.2 Texland Great Plains Water Supply Co. LLC

The Texland Great Plains Water Supply Company (Great Plains) is a wholesale water provider (WWP) that provides water to customers in Region F and the Llano Estacado Region (Region O). The water supply system operates well fields in the Ogallala aquifer in Andrews County in Region F and Gaines County in Region O. Great Plains owns an extensive pipeline system that has historically provided water primarily for oil and gas operations. In Region F, Great Plains also provides a small amount of municipal water to the City of Goldsmith, manufacturing users and a steam electric operation in Ector County. Due to the limited supplies from the Ogallala aquifer in Andrews and Gaines Counties, Great Plains is shown to have a projected shortage of approximately 40 acre-feet per year in 2020 and 180 acre-feet by 2070, as presented in Table 5E- 2.

Table 5E- 2
Comparison of Supply and Demand for the Great Plains Water Supply System
-Values are in Acre-Feet per Year-

Supplies	2020	2030	2040	2050	2060	2070
Andrews Co. Well Field	1,782	1,631	1416	1283	1171	1072
Gaines Co. Well Field	4,731	4,781	4,838	4,929	5,007	5,075
Total Supplies	**6,513**	**6,412**	**6,254**	**6,212**	**6,178**	**6,147**
Demands	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
County-Other, Ector (City of Goldsmith)	68	68	68	68	68	68
Steam Electric Power, Ector County	3,716	3,716	3,716	3,716	3,716	3,716
Manufacturing, Ector County	245	245	245	245	245	245
Mining, Andrews County	50	50	50	50	50	50
Mining, Ector County	375	300	150	150	150	150
Mining, Gaines County	2,100	2,100	2,100	2,100	2,100	2,100
Total Demand	**6,554**	**6,479**	**6,329**	**6,329**	**6,329**	**6,329**
Shortage	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Shortage	41	67	75	117	151	182

These shortages are associated with the limitations of the MAGs. The existing well fields can produce the required supply but there is competition for water from the Ogallala aquifer. In Andrews County there is no groundwater district to enforce the MAG withdrawal limits, but there is a district in Gaines County. For planning purposes there is no available water from the Ogallala aquifer in Andrews and/or Gaines County for water management strategies. There is a small amount of MAG available in Andrews County from the Dockum aquifer, but the water quality of this supply is poor, and productivity is limited.

In order to meet any potential future needs, Great Plains is planning to expand their well field and drill new wells in northern Andrews County and/or southern Gaines County. Due to limitations of the MAG in both Andrews and Gaines County, this is shown as an alternative strategy in the plan.

Potentially Feasible Water Management Strategies Considered for Texland Great Plains:

- Develop Ogallala & Edwards-Trinity-High Plains Aquifer Supplies

Alternative Water Management Strategies for Texland Great Plains:

- Develop Additional Supplies in Ogallala & Edwards-Trinity-High Plains Aquifer from Andrews and Gaines Counties

Texland Great Plains Recommended Strategies

- None. Texland Great Plains groundwater development is considered Alternative due to MAG limitations.

Develop Additional Ogallala Aquifer Supplies from Andrews or Gaines County

This strategy is for a small well field expansion at Texland Great Plains existing facilities in Andrews and Gaines counties. This strategy assumes one new well in the Ogallala Aquifer. Due to MAG limitations in these counties, this strategy is classified as Alternative.

Table 5E- 3
Recommended Water Strategies for Great Plains

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		6,554	6,479	6,329	6,329	6,329	6,329
Existing Supply (Groundwater)		6,513	6,412	6,254	6,212	6,178	6,147
Shortage		41	67	75	117	151	182
Alternative Strategies							
Develop Additional Supplies in Ogallala & Edwards-Trinity-High Plains Aquifers	$380,000	200	200	200	200	200	200

5E.1.3 Andrews County Other

Andrews County Other has less than 4,428 in population, including individuals living outside of a named water user group. This compilation of users known as County-Other is self-supplied. The shortages for this population stem from limited MAG availability in the county and therefore additional groundwater development is considered as an alternative water management strategy. Since Andrews County has no GCD, there is no one to issue permits or manage production to meet the DFC. Municipal conservation was also considered and recommended as a strategy for Andrew County Other. Conservation strategies are discussed in Chapter 5B.

Potentially Feasible Water Management Strategies Considered for Andrews County Other:

- Municipal Conservation
- Develop Edwards-Trinity-Plateau Aquifer Supplies

Alternative Water Management Strategies for Andrews County Other:

- Develop Edwards-Trinity-Plateau Aquifer Supplies

Develop Edwards-Trinity Plateau Aquifer Supplies

This strategy assumes that 5 new wells will need to be constructed at a 150-ft depth in order to access the additional aquifer supplies needed. Each well is assumed to be operating at a capacity of 50 gpm. This strategy will cost approximately $751,000 to implement and is estimated to yield an additional 250 acre-feet of water per year.

Andrews County Other Recommended Strategies

- Municipal Conservation
- Groundwater development for Andrews County Other is considered Alternative due to MAG limitations.

Table 5E- 4
Recommended Water Strategies for Andrews County Other

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		537	577	618	666	720	776
Existing Supply (Groundwater)		507	519	527	514	508	501
Shortage		30	58	91	152	212	275
Recommended Strategies							
Municipal Conservation	**$0**	14	15	17	18	20	25
Alternative Strategies							
Develop Edwards-Trinity (Plateau) Aquifer Supplies	$751,000	250	250	250	250	250	250

5E.1.4 Andrews County Livestock

Andrews County has approximately 10 to 60 acre-feet of livestock shortages over the planning horizon due to MAG limitations in the county. An alternative water management strategy is included to provide additional water from the Edwards-Trinity Plateau aquifer.

Andrews County Livestock Recommended Strategies

- None. Groundwater development for Andrews County Livestock is considered Alternative due to MAG limitations.

Potentially Feasible Water Management Strategies Considered for Andrews County Livestock:

- Develop Edwards-Trinity Plateau Supplies

Alternative Water Management Strategies for Andrews County Livestock:

- Develop Edwards-Trinity Plateau Supplies

Develop Edwards-Trinity-Plateau Aquifer Supplies

This strategy assumes that 3 new wells will need to be constructed at a 150-ft depth in order to access the additional aquifer supplies needed. Each well is assumed to be operating at a capacity of 20 gpm. This strategy will cost approximately $327,000 to implement and is estimated to yield an additional 60 acre-feet of water per year.

Table 5E- 5
Recommended Water Strategies for Andrews County Livestock

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		210	210	210	210	210	210
Existing Supply (Groundwater)		201	193	185	171	160	150
Shortage		9	17	25	39	50	60
Alternative Strategies							
Develop Edwards-Trinity (Plateau) Aquifer Supplies	$327,000	60	60	60	60	60	60

5E.1.5 Andrews County Manufacturing

A small portion of the Andrews County manufacturing demand is supplied through sales from the City of Andrews. The remainder of the manufacturing in the county is self-supplied from the Dockum and Ogallala Aquifer & Edwards-Trinity-High Plains Aquifers. Due to limited supplies under the MAG, manufacturing in Andrews County also shows a shortage over the planning horizon that cannot be met. An alternative water management strategy for additional groundwater from the Edwards-Trinity-Plateau Aquifer was developed.

Potentially Feasible Water Management Strategies Considered for Andrews County Manufacturing:

- Develop Edwards-Trinity Plateau Supplies

Alternative Water Management Strategies for Andrews County Manufacturing:

- Develop Edwards-Trinity Plateau Supplies

Andrews County Manufacturing Recommended Strategies

- None. Groundwater development for Andrews County Livestock is considered Alternative due to MAG limitations.

Develop Edwards-Trinity-Plateau Aquifer Supplies

This strategy assumes that 4 new wells operating at 50 gpm constructed at a 150-ft depth to access the additional aquifer supplies needed. This strategy will cost approximately $591,000 to implement and is estimated to yield an additional 210 acre-feet of water per year.

Table 5E-6
Recommended Water Strategies for Andrews County Manufacturing

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		580	617	617	617	617	617
Existing Supply (Groundwater, Purchased from Andrews)		549	558	530	483	443	408
Shortage		31	59	87	134	174	209
Alternative Strategies							
Develop Edwards-Trinity Plateau Aquifer Supplies	$591,000	210	210	210	210	210	210

5E.1.6 Andrews County Mining

Andrews County Mining has a projected shortage from 2020 to 2040, with a shortage of nearly 1,200 acre-feet per year in 2020. Region F has identified mining conservation (recycling) as recommended strategy. Additional information on conservation strategies is included in Chapter 5B. The remainder of the need is unmet since the groundwater available under the MAG is limited and mining is an exempt use. However, it is anticipated that the mining industry, as an exempt user, will continue to use groundwater as needed to meet any of their demands.

5E.1.7 Andrews County Summary

Before strategies, Andrews County has a projected shortage of over 12,000 acre-feet per year by 2070 and has limited options under regional planning guidelines to meet these shortages. The MAG in Andrews County is limiting and results in water needs for all users in the county. Most of these needs remain unmet. However, since there is no GCD in Andrews County, users may functionally develop supplies in larger quantities than regional planning recognizes. While the unmet needs are large, some of the need is currently being met by groundwater use above the MAG limits. It is anticipated that the water users in Andrews County will continue to use groundwater at the current levels and possibly expand groundwater use over time. These strategies are included as alternative water management strategies.

Table 5E- 7
Andrews County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Andrews	Ogallala Aquifer & Edwards-Trinity-High-Plains Aquifer	192	2,800	Municipal Conservation Develop Edwards-Trinity Plateau Supplies (Alternative)
County-Other	Ogallala Aquifer & Edwards-Trinity-High-Plains Aquifer	30	275	Municipal Conservation Develop Edwards-Trinity Plateau Supplies (Alternative)
Texland Great Plains	Ogallala Aquifer & Edwards-Trinity-High-Plains Aquifer	42	182	Develop Ogallala Aquifer & Edwards-Trinity-High-Plains Aquifer Supplies (Alternative)
Irrigation	Ogallala Aquifer & Edwards-Trinity High Plains Aquifer, Edwards-Trinity-High Plains Aquifer, Reuse (Andrews)	1,699	9,317	Irrigation Conservation
Livestock	Dockum Aquifer, Stock Ponds, Ogallala Aquifer & Edwards-Trinity-High Plains Aquifer	9	60	Develop Edwards-Trinity Plateau Supplies (Alternative)
Manufacturing	Sales from Andrews, Dockum Aquifer, Ogallala Aquifer & Edwards-Trinity-High Plains Aquifer	31	209	Develop Edwards-Trinity Plateau Supplies (Alternative)
Mining	Ogallala Aquifer & Edwards-Trinity-High Plains Aquifer, Dockum Aquifer	2,934	473	Mining Conservation/Recycling
Steam Electric	----	----	----	----

Table 5E- 8
Unmet Needs in Andrews County
-Values are in Acre Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Andrews	147	361	619	1,186	1,850	2,650
County Other	16	43	74	134	192	254
Livestock	9	17	25	39	50	60
Manufacturing	31	59	87	134	174	209
Irrigation	681	3,651	5,260	6,352	7,275	8,097
Mining	909	868	66	0	0	0
TOTAL	**1,793**	**4,999**	**6,132**	**7,845**	**9,541**	**11,270**

5E.2 Borden County

Borden County has limited surface water and groundwater supplies. Some local surface water is used by livestock, but the majority of water within Borden County is supplied from the Ogallala aquifer and Other aquifer. Much of the supply from these sources is nearly fully developed for current use. Irrigation is the largest water user within the county with a water demand of roughly 2,950 acre-feet per year. All of the shortages in Borden County are for irrigation; however, it is estimated that these shortages can be met by conservation. Conservation strategies are discussed in more detail in Chapter 5B. All other water use categories in Borden County, including county-other, livestock, and mining, were identified to not have shortages and therefore no strategies were required.

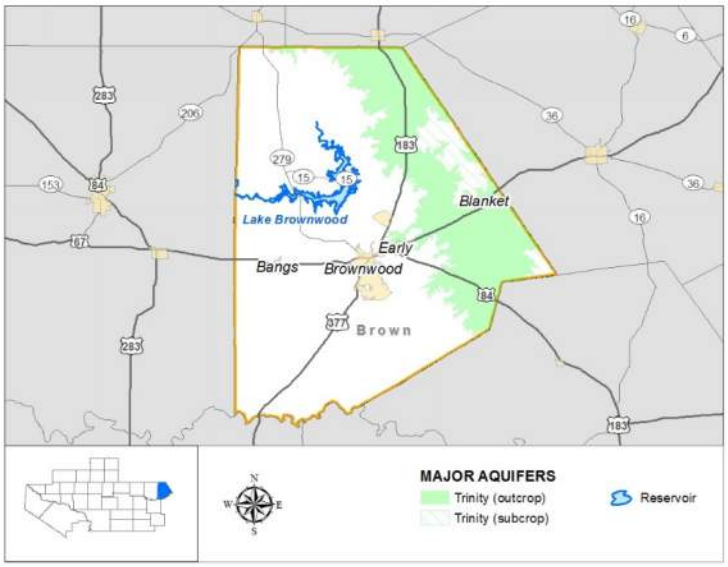
5E.2.1 Borden County Summary

Table 5E- 9
Borden County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
County-Other	Ogallala Aquifer, Local Alluvium Aquifer	None	None	None
Irrigation	Ogallala Aquifer, Local Alluvium Aquifer	0	282	Irrigation Conservation
Livestock	Stock Ponds	None	None	None
Manufacturing	----	----	----	----
Mining	Local Alluvium Aquifer	None	None	Mining Conservation/Recycling
Steam Electric	----	----	----	----

5E.3 Brown County

Most of the water supply in Brown County is supplied by Brown County Water Improvement District #1 (BCWID) from Lake Brownwood. None of the entities supplied by BCWID #1 show a water shortage over the planning horizon. BCWID #1 is classified as a major water provider and is discussed further in Chapter 5D. Coleman County SUD, as well as irrigation and mining users, show a water shortage over the planning horizon. The identified shortage for Coleman County SUD is attributed to a lack of firm yield in Lake Coleman. When considering subordination supply from Lake Coleman, the shortages for Coleman County SUD are met. Mining customers are supplied entirely by groundwater and their shortages can be met through the development of additional groundwater supplies. Irrigation users receive their supply through various sources, however, the only recommended strategy in the plan is conservation.



Conservation is recommended as strategy in Brown County for municipal, irrigation, and mining. All conservation strategies are further discussed in Chapter 5B. The City of Bangs, which does not have a need, plans to pursue a direct non-potable reuse strategy. County-Other, Livestock and Manufacturing all have no shortages and no recommended strategies.

5E.3.1 Bangs

Bangs is a customer of BCWID and has no shortages over the planning horizon. However, Bangs plans to pursue a small scale direct non-potable reuse project for irrigation at a golf course.

Potentially Feasible Water Management Strategies Considered for Bangs:

- Municipal Conservation
- Direct Non-Potable Reuse

Bangs Recommended Strategies

- Municipal Conservation
- Direct Non-Potable Reuse

Direct Non-Potable Reuse

For the purposes of this plan, it was assumed that minor improvements would need to be made at the wastewater treatment facility as well as additional piping to transport the water from the plant to the golf course. This strategy will provide approximately 25 acre-feet per year and is estimated to cost approximately $581,000.

Table 5E- 10
Recommended Water Strategies for Bangs

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		310	305	296	291	290	290
Existing Supply (Purchased from BCWID #1)		310	305	296	291	290	290
Shortage		0	0	0	0	0	0
Recommended Strategies							
Municipal Conservation	$0	8	8	8	8	8	8
Reuse	$581,000	25	25	25	25	25	25
TOTAL	**$0**	**33**	**33**	**33**	**33**	**33**	**33**

5E.3.2 Brown County Mining

Brown County Mining Recommended Strategies

- Mining Conservation (Recycling)
- Develop Cross Timbers Aquifer Supplies

Brown County Mining is projected to have water shortages ranging from 261 to 268 acre feet per year throughout the planning horizon. Currently, mining customers in Brown County are supplied entirely by groundwater from the Trinity Aquifer and Cross Timbers Aquifer. Region F identified further development of these groundwater supplies to meet the projected shortages.

Potentially Feasible Water Management Strategies Considered for Bangs:

- Mining Conservation (Recycling)
- Develop Cross Timbers Aquifer Supplies

Develop Cross Timbers Aquifer Supplies

This strategy assumes that 45 new wells will need to be constructed at a 320-ft depth in order to access the additional aquifer supplies needed. Each well is assumed to be operating at a capacity of 5 gpm. This strategy will cost approximately $3.3 million to implement and is estimated to yield an additional 210 acre-feet of water per year.

Table 5E- 11
Recommended Water Strategies for Brown County Mining

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		943	948	951	952	948	944
Existing Supply (Groundwater)		682	682	685	684	684	681
Shortage		261	266	266	268	264	263
Recommended Strategies							
Mining Conservation/Recycling	$1,340,000	66	66	67	67	66	66
Develop Cross Timbers Aquifer Supplies	$2,440,000	210	210	210	210	210	210
TOTAL	**$3,780,000**	**276**	**276**	**277**	**277**	**276**	**276**

5E.3.3 Brown County Summary

Lake Brownwood (BCWID #1) has sufficient supplies to meet most of the county's demands. Development of additional groundwater supplies is necessary to meet shortages for mining. Conservation is recommended for all municipal, irrigation, and mining users. Irrigation is the only entity that has unmet needs over the planning horizon.

Table 5E- 12
Brown County Summary

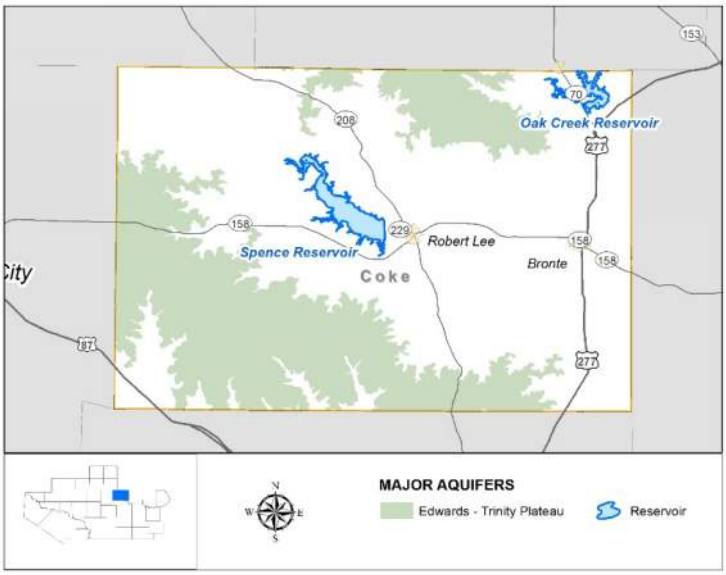
Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Bangs	Sales from BCWID #1	None	None	Municipal Conservation Direct Non-Potable Reuse
Brookesmith SUD	Sales from BCWID #1	None	None	Municipal Conservation
Brownwood	Sales from BCWID #1	None	None	Municipal Conservation
Coleman County SUD	Sales from BCWID #1 and City of Coleman	227	215	Municipal Conservation Subordination (through the City of Coleman)
Early	Sales from BCWID #1	None	None	Municipal Conservation
Santa Anna	Sales from BCWID #1	None	None	Municipal Conservation
Zephyr WSC	Sales from BCWID #1	None	None	Municipal Conservation
County-Other	Sales from Brownwood, Trinity Aquifer	None	None	None
Irrigation	Sales from BCWID #1, Run-of-River, Trinity Aquifer	1,708	1,711	Irrigation Conservation
Livestock	Livestock Local Supplies, Other Aquifer	None	None	None
Manufacturing	Sales from BCWID #1	None	None	None
Mining	Trinity and Other Aquifers	195	197	Mining Conservation/Recycling Develop Cross Timbers Aquifer Supplies
Steam Electric	----	----		----

Table 5E- 13
Unmet Needs in Brown County
-Values are in Acre Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Irrigation	1,302	1,062	1,061	1,063	1,060	1,061

5E.4 Coke County

Coke County has very limited groundwater and surface water supplies. Without subordination both E.V. Spence and Oak Creek Reservoir show zero reliable supply. Lake Spence is owned and operated by CRMWD. The subordination supplies from this reservoir go to supply CRMWD customers outside Coke County. Robert Lee previously had a contract with CRMWD and previously received supply from the Spence Reservoir. However, their water treatment plant has been shuttered and their contract has expired. Robert Lee no longer uses this source. Oak Creek Reservoir is owned and operated by the City of Sweetwater (Region G) and is used in conjunction with their other supplies to provide water to Sweetwater and their customers, including Bronte. Groundwater supply in the county is also limited. There are some small alluvium deposits of freshwater but they are limited and generally not prolific. The Edwards-Trinity Plateau aquifer does have unused availability in the county but the quality tends to be poor and may require advanced treatment for municipal use. For many of the smaller, rural communities in Coke County, the development of this supply is economically infeasible.



5E.4.1 Bronte

In the past, the City of Bronte relied solely on water from the Oak Creek Reservoir (sales from the City of Sweetwater located in Region G). However, prolonged drought has greatly impacted the supply available from Oak Creek and without subordination, the source shows no supply. As a result, Bronte developed a groundwater supply from ten wells in the vicinity of Oak Creek Reservoir. The groundwater is delivered to the City in the Oak Creek pipeline. The groundwater supply is from an unclassified aquifer and the reliability is not well known. For the purpose of this plan, it is assumed that this source could provide about 130 acre-feet of supply per year. Assuming the City of Sweetwater is able to meet their full obligation to Bronte, they show no shortages over the planning horizon. However, if Sweetwater is not able to meet this amount, Bronte would show significant shortages. To ensure the security of their water supply, the City of Bronte is diligently pursuing all options. Several strategies for Bronte in previous plans were evaluated and some were considered economically infeasible. These were not reevaluated for this plan and are listed below.

Previously Evaluated and Dismissed Water Management Strategy:

- Brackish groundwater development with advanced treatment
- Direct Potable Reuse

For this plan, several potentially feasible strategies were considered for Bronte including:

- Municipal Conservation
- Subordination (Oak Creek Supplies from Sweetwater)
- Rehabilitation and Upsizing of the Oak Creek Pipeline
- Water Treatment Plant Expansion
- Regional System from Lake Brownwood to Runnels and Coke Counties
- Regional System from Fort Phantom Hill to Runnels and Coke Counties
- Develop Other Aquifer Supplies in Southwest Coke County
- Develop Edwards-Trinity Plateau Supplies in Nolan County
- Develop Other Aquifer Supplies in Runnels County

Bronte Recommended Strategies

- Municipal Conservation
- Subordination (Oak Creek Reservoir)
- Rehabilitation and Upsizing of Oak Creek Pipeline
- Water Treatment Plant Expansion
- Develop Other Aquifer Supplies in Southwest Coke County

Recommended strategies for the City of Bronte are discussed below. Alternate strategies are described further in Appendix C.

Rehabilitation and Upsizing of the Oak Creek Pipeline

The City of Bronte has a 13-mile pipeline to Oak Creek Reservoir. This pipeline is approximately 60 years old and in need of replacement and upsizing to provide adequate capacity. The proposed strategy includes a new 50,000-gallon/ground storage tank, upgrades to the pump station at the intake, and 13 miles of 14-inch pipeline. The additional yield from this strategy represents the additional supplies (subordination sales from Sweetwater) that were previously constrained by the pipeline's capacity. The strategy is estimated to cost nearly $9.8 million dollars.

Water Treatment Plant Expansion

In order to continue supplying Bronte's municipal needs and treated water sales to Robert Lee, the City of Bronte will need a 1.5 MGD water treatment plant expansion in 2020. This is estimated to cost $10.3 million.

Develop Other Aquifer Supplies in Southwest Coke County

The Coke County Underground Water District has done some groundwater exploration in Southwest Coke County. Bronte is considering developing 5 new wells in this area. It is estimated that the wells would produce around 100 gpm from a 300 ft depth and be of adequate quality for municipal use without advanced treatment. A 31-mile transmission pipeline would be needed to deliver these supplies to the City. Capital costs are estimated at $23.7 million.

Table 5E- 14
Recommended Water Strategies for Bronte

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		577	573	569	566	566	566
Existing Supply (Groundwater)		129	125	121	120	120	120
Shortage		448	448	448	446	446	446
Recommended Strategies							
Subordination (Oak Creek Reservoir)	$0	448	448	448	446	446	446
Municipal Conservation		3	3	3	3	3	3
*Oak Creek Pipeline Rehabilitation**	*$9,896,000*	*448*	*448*	*448*	*446*	*446*	*446*
*Water Treatment Plant Expansion**	*$10,270,000*	*448*	*448*	*448*	*446*	*446*	*446*
Develop Other Aquifer Supplies in Southwest Coke County	$23,694,000	800	800	800	800	800	800
TOTAL	**$43,860,000**	**1,251**	**1,251**	**1,251**	**1,249**	**1,249**	**1,249**

**This strategy is for infrastructure projects required to access the subordination supplies Oak Creek pipeline supplies and is not included in the total to avoid double counting.*

Alternative Water Management Strategies for Bronte include:

- Regional System from Lake Brownwood to Runnels and Coke Counties
- Regional System from Fort Phantom Hill to Runnels and Coke Counties
- Develop Edwards-Trinity Plateau Supplies in Nolan County
- Develop Other Aquifer Supplies in Runnels County

5E.4.2 Robert Lee

The City of Robert Lee provides water to its current customers and about 10 acre-feet to Coke County WSC (Coke County Other). It currently purchases all of its supply from the City of Bronte. The City previously owned and operated a surface water treatment plant for water supplied by Spence and Mountain Creek Reservoirs. However, due to prolonged drought, these water sources became unreliable and the water treatment plant was shuttered. The City is currently pursuing several different water supply options. Additionally, several other strategies have previously been evaluated for Robert Lee that were found to be economically infeasible and are listed below.

Previously Evaluated and Dismissed Water Management Strategies:

- Regional System from Lake Brownwood to Runnels and Coke Counties
- Desalination of Spence Reservoir Water
- Floating pump in Mountain Creek Reservoir
- Direct Potable Reuse

Potentially Feasible Water Management Strategies Considered for Robert Lee:

- Municipal Conservation
- Purchase additional water from Bronte
- Regional System from Fort Phantom Hill to Runnels and Coke Counties
- New water treatment plant to utilize supply from Spence and Mountain Creek Reservoirs
- Develop groundwater from Edwards-Trinity Plateau in Nolan County
- Develop groundwater from Edwards-Trinity Plateau in Tom Green County

Purchase Additional Water from Bronte

Robert Lee Recommended Strategies

- Municipal Conservation
- Subordination (Bronte Supplies)
- Purchase Additional Supply from Bronte

The City of Robert Lee currently has a contract to purchase 224 acre-feet per year of supply from Bronte. It is recommended that Robert Lee increase this amount to meet their water supply needs. This strategy assumes this is done on willing buyer, willing seller basis. The recommended strategies for Robert Lee are shown in the table below. The shortages reported in this table include shortages to County-Other that Robert Lee currently supplies. Water made available to Robert Lee from these strategies will be used to meet the County-Other demands.

Table 5E- 15
Recommended Water Strategies for Robert Lee

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		305	300	296	296	295	295
Existing Supply (Purchased)		68	66	65	65	65	65
Shortage		237	234	231	231	230	230
Recommended Strategies							
Municipal Conservation	$0	3	3	3	3	3	3
Subordination (existing contract with Bronte)	$0	156	158	159	159	159	159
Purchase Additional Supply from Bronte	$0	80	80	80	80	80	80
TOTAL	**$0**	**239**	**241**	**242**	**242**	**242**	**242**

Alternative Water Management Strategies Considered for Robert Lee:

- New water treatment plant to utilize supply from Spence and Mountain Creek Reservoirs
- Regional Systems from Fort Phantom Hill to Runnels and Coke Counties
- Develop Edwards-Trinity Plateau Aquifer in Nolan County
- Develop Edwards-Trinity Plateau Aquifer in Tom Green County

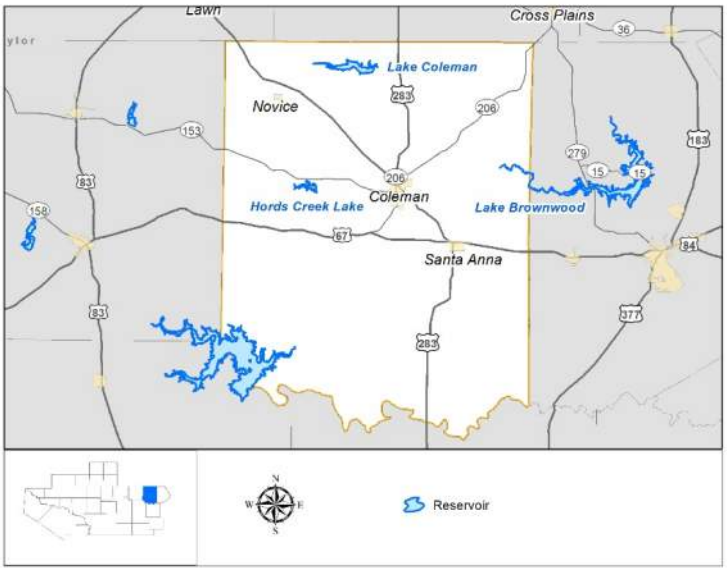
5E.4.3 Coke County Summary

After subordination of downstream water rights associated with Oak Creek Reservoir, Coke County has a no official water needs. However, the ability to meet this need is dependent on Sweetwater continuing to provide adequate supplies from Oak Creek reservoir. The ability to develop additional water supplies through economically feasible strategies is limited. Both the local groundwater and surface water have known water quantity and quality limitations. The ability to use these sources for municipal purposes would likely require advanced treatment. The entities in Coke County continue to explore their options.

Table 5E- 16
Coke County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Bronte	Sales from Sweetwater, Other Undifferentiated Aquifer	368	366	Municipal Conservation, Subordination, Rehabilitation of Oak Creek Pipeline, New Groundwater in Southwest Coke County
Robert Lee	CRMWD, Run-of-River, Sales from Bronte	247	240	Municipal Conservation, Subordination (through Bronte), Purchase Additional Supplies from Bronte
County-Other	Edwards-Trinity Plateau Aquifer, Other Undifferentiated Aquifer	None	None	None
Irrigation	Run-of-River, Edwards-Trinity-Plateau Aquifer, Other Undifferentiated Aquifer	None	None	Irrigation Conservation
Livestock	Stock Ponds, Edwards-Trinity-Plateau Aquifer, Other Undifferentiated Aquifer	None	None	None
Manufacturing	----	----	----	----
Mining	Edwards-Trinity-Plateau Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	Oak Creek Reservoir	None	None	None

5E.5 Coleman County



Users in Coleman County largely rely on surface water. Many water user groups including Brookesmith SUD, Coleman County SUD, and Santa Anna are supplied by Brown County WID #1 from Lake Brownwood. These entities are discussed further under Brown County. The City of Coleman is supplied by Lake Coleman and Hords Creek. Irrigators in Coleman County rely primarily on Lake Coleman and run-of-river rights for their supply, but also pump some groundwater from the Cross Timbers Aquifer. Mining users are supplied entirely by groundwater from other undifferentiated aquifers, while livestock users utilize local water supplies to meet their demands.

Without subordination, Lake Coleman and Hords Creek show no supply, leaving irrigators, the City of Coleman and the City's customers including Coleman County SUD, County-Other, and manufacturing with shortages. However, when considering conservation and subordination, supplies are adequate to meet all these shortages and no additional infrastructure strategies are needed. Conservation and subordination are discussed further in Chapters 5B and 5C, respectively.

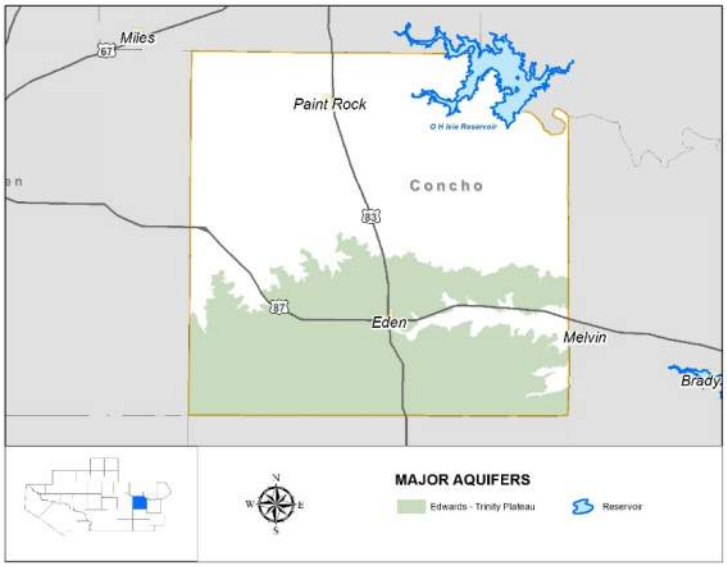
5E.5.1 Coleman County Summary

After subordination of downstream water rights, Coleman County has no water shortages. Although there is no need, conservation is recommended for irrigation and mining users, as well as for municipal users (City of Coleman, Brookesmith SUD, Coleman County SUD, Santa Anna).

Table 5E- 17
Coleman County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Brookesmith SUD		See Brown County		
Coleman	Lake Coleman, Hords Creek	1,074	1,030	Municipal Conservation, Subordination
Coleman County SUD		See Brown County		
Santa Anna		See Brown County		
County-Other	Sales from Coleman	24	21	None
Irrigation	Run-of-River, Lake Coleman, Cross Timbers Aquifer	396	396	Irrigation Conservation, Subordination
Livestock	Livestock Local Supplies, Other Aquifer	None	None	None
Manufacturing	Sales from Coleman	None	None	None
Mining	Other Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	----	----		----

5E.6 Concho County



Concho County is primarily dependent on groundwater supplies from the Hickory, Edwards-Trinity Plateau, Lipan, and other undifferentiated aquifers. The City of Eden uses a small amount of reuse supplies for local golf course. The amount of supply available from these sources is shown to be adequate for most users in Concho County. Other sources of water supply in Concho County include run-of-river supplies for irrigators and County-Other users, as well as sales from the Upper Colorado River Authority (UCRA) to Concho County-Other users. Chapter 5D contains more details regarding sales from UCRA. Overall, Concho County is shown to have no water shortages throughout the planning horizon.

Conservation is recommended for municipal, irrigation, and mining users. Conservation is discussed further in Chapter 5B. Millersview-Doole WSC is split between Concho and McCulloch Counties. Further discussion on Millersview-Doole is discussed under McCulloch County.

5E.6.1 Concho County Summary

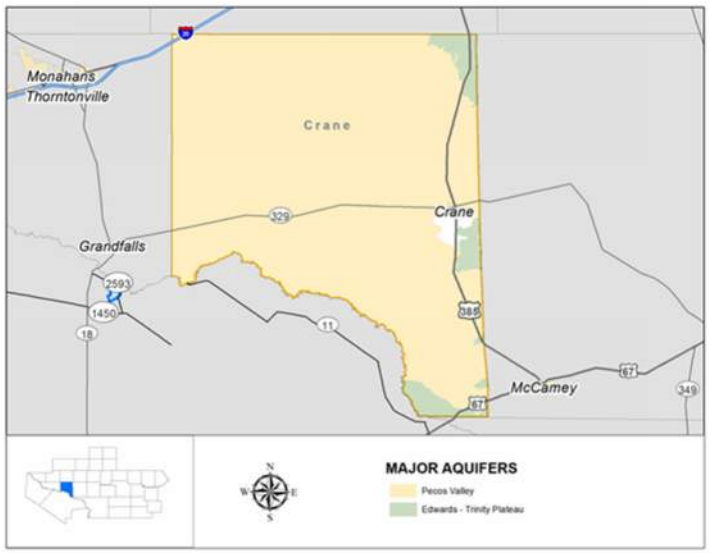
The total shortage for Concho County is projected to be approximately 5,500 acre-feet in 2020. The entire shortage is associated with irrigation and mining demands. Some of this need is met through conservation which is discussed in detail in Chapter 5B. Beyond conservation, the remaining water need for Concho County Mining can be met through the development of the Hickory aquifer supplies. However, the remaining 4,762 acre-feet of shortage for irrigation will remain unmet due to a lack of viable options.

Table 5E- 18
Concho County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
County Other	Sales from Eden, Edwards-Trinity Plateau, Pecos Valley & Trinity Aquifer, Other Aquifer, Run-of-River, Sales from UCRA	None	None	None
Eden	Edwards-Trinity Plateau, Pecos Valley & Trinity Aquifer, Other Aquifers, Reuse	None	None	Municipal Conservation
Millersview-Doole WSC	See McCulloch County			
Irrigation	Run-of-River, Lipan Aquifer, Other Aquifers	None	None	Irrigation Conservation
Livestock	Livestock Local Supplies, Edwards-Trinity Plateau, Pecos Valley & Trinity Aquifer	None	None	None
Manufacturing	----	----	----	----
Mining	Other Aquifers	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.7 Crane County

Crane County has limited surface water and groundwater supplies. Some local surface water is used by livestock, but the majority of water within Crane County is supplied from the Pecos Valley and Pecos Valley-Edwards-Trinity Plateau aquifers. The largest water demand in Crane County is affiliated with the City of Crane and the surrounding rural communities that are classified as County-Other. The City of Crane and County-Other currently obtain water from the Pecos Valley and Pecos Valley-Edwards-Trinity Plateau aquifers in Crane and Ward counties. In addition, the City of Crane utilizes a small amount of reuse water for golf course irrigation.



Municipal users and all other users (livestock, mining) in Crane County were identified to have no water shortages throughout the planning horizon. Municipal and mining conservation (recycling) were identified as viable means of preserving existing supplies and are recommended strategies. These conservation strategies will provide the opportunity to reduce the use of groundwater and local supplies within Crane County and are discussed in more detail in Chapter 5B.

5E.7.1 Crane County Summary

Table 5E- 19
Crane County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Crane	Pecos Valley Edwards-Trinity Plateau, Reuse	None	None	Municipal Conservation
County-Other	City of Crane	None	None	None
Irrigation	----	----	----	----
Livestock	Pecos Valley Edwards-Trinity Plateau, Stock Ponds	None	None	None
Manufacturing	Pecos Valley Edwards-Trinity Plateau Aquifer, Dockum Aquifer	None	None	None
Mining	Pecos Valley Edwards-Trinity Plateau Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.8 Crockett County

Almost all of the current water supply in Crockett County is derived from the Edwards-Trinity Plateau aquifer. Mining currently uses an estimated 1,900 acre-feet per year of reuse/recycling supplies. No users in Crockett County are shown to have a shortage over the planning horizon.

5E.8.1 Crockett County Irrigation

Although Crockett County Irrigation shows no shortage, both conservation and weather modification are recommended strategies. Crockett County lies in the West Texas Weather Modification Association program area, where precipitation enhancement is currently active.

Crockett County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Potentially Feasible Water Management Strategies Considered for Crockett County Irrigation:

- Irrigation Conservation
- Weather Modification

Weather Modification

The West Texas Weather Modification Association attributes an annual increase of 1.14 inches of precipitation over Crockett County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 13 irrigated acres in Crockett County, implementation of this strategy is expected to save 1 acre-foot of water per year at a unit cost of $0.47 per acre-foot.

Table 5E- 20
Recommended Water Strategies for Crockett County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		135	135	135	135	135	135
Supply (Groundwater)		135	135	135	135	135	135
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$15,000	7	14	20	20	20	20
Weather Modification	$0	1	1	1	1	1	1
TOTAL	**$15,000**	**8**	**15**	**21**	**21**	**21**	**21**

5E.8.2 Crockett County Summary

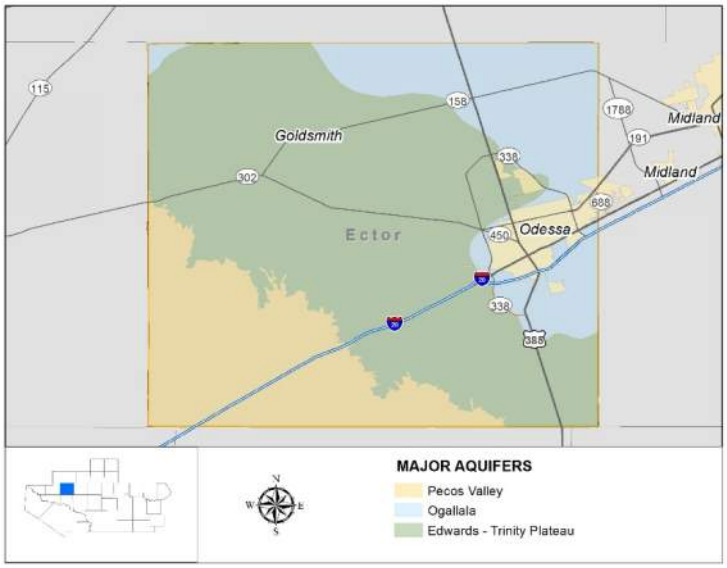
Crockett County shows adequate supplies to meet all users' needs throughout the planning period. Conservation remains recommended for Crockett County WCID #1, Irrigation, and Mining to preserve supplies for future use. Weather modification as part of the West Texas Weather Modification Association is also recommended for irrigators in Crockett County.

Table 5E- 21
Crockett County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Crockett County WCID #1	Edwards-Trinity Plateau, Pecos Valley, And Trinity Aquifer	None	None	Municipal Conservation
County-Other	Edwards-Trinity Plateau, Pecos Valley, And Trinity Aquifer	None	None	None
Irrigation	Edwards-Trinity Plateau, Pecos Valley, And Trinity Aquifer	None	None	Irrigation Conservation Weather Modification
Livestock	Edwards-Trinity Plateau, Pecos Valley, And Trinity Aquifer	None	None	None
Manufacturing	Sales Crockett County WCID #1	None	None	None
Mining	Edwards-Trinity Plateau, Pecos Valley, And Trinity Aquifer, Well Field Recycling	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.9 Ector County

A large portion of the supply and demand in Ector County stems from the City of Odessa. Odessa is a member city of CRMWD and receives all of its supply from their system. Recommended strategies for Odessa include conservation, a new advanced water treatment plant, and subordination of CRMWD's supplies. The City of Odessa is considered a major water provider and is discussed in detail in Chapter 5D. The rest of Ector County is primarily reliant on groundwater from several aquifers, including the Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer, Ogallala Aquifer, Dockum Aquifer, and Other Aquifer. Shortages in Ector County mostly stem from growth in local municipalities, such as Ector County Utility District (ECUD) and Greater Gardendale Water Supply Corporation (WSC), and from steam electric power generating demands. The remaining water users all show no shortages after subordination.



5E.9.1 Ector County Utility District

Ector County Utility District Recommended Strategies

- Municipal Conservation

The Ector County Utility District (ECUD) receives all of its supplies from the City of Odessa. ECUD has plans to expand their service area and has already received major funding to upgrade and expand their system. Future expansion of ECUD's service is accounted for in regional planning as future sales to the County Other population they would incorporate. These additional sales are based on a more detailed master plan that ECUD completed in June 2018. The future needs of Ector County UD were planned for under the Odessa as a major provider in Chapter 5D. As a member city of CRMWD, Odessa's needs, including their customers' needs will be met through additional supplies from CRMWD and their strategies.

5E.9.2 Greater Gardendale WSC

Greater Gardendale WSC is currently reliant on groundwater from the Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifers. However, this source is not expected to be sustainable at the current withdrawal rate, which will induce shortages after 2020. Consequently, purchasing additional water from the City of Odessa was identified as a recommended strategy for Greater Gardendale WSC to offset the decrease in groundwater supply reliability and to meet growing, future demands. Municipal conservation was also recommended as a strategy for Greater Gardendale WSC. Conservation is discussed further in Chapter 5B.

Potentially Feasible Water Management Strategies Considered for Greater Gardendale WSC:

- Municipal Conservation
- Purchase Water from City of Odessa
- Purchase Water from Midland FWSD #1

Purchase Water from City of Odessa

Greater Gardendale WSC plans to purchase water from the City of Odessa in order to compensate for growing water demands and declining groundwater levels. This strategy requires additional infrastructure to connect to Odessa's water distribution system. Details regarding the project for this additional infrastructure are discussed in Appendix C.

Greater Gardendale WSC Recommended Strategies

- Municipal Conservation
- Purchase Water from City of Odessa

Table 5E- 22
Recommended Water Management Strategies for Greater Gardendale WSC

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		319	348	379	416	457	499
Existing Supply (Groundwater)		319	222	222	222	222	222
Shortage		0	126	157	194	235	277
Recommended Strategies							
Municipal Conservation	**$0**	12	13	15	17	19	20
Purchase Water from Odessa	$6,078,000	0	375	445	445	445	445
TOTAL	**$6,078,000**	**12**	**388**	**460**	**462**	**464**	**465**

Alternative Water Management Strategies for Greater Gardendale WSC:

- Purchase Water from Midland FWSD #1

5E.9.3 Ector County Summary

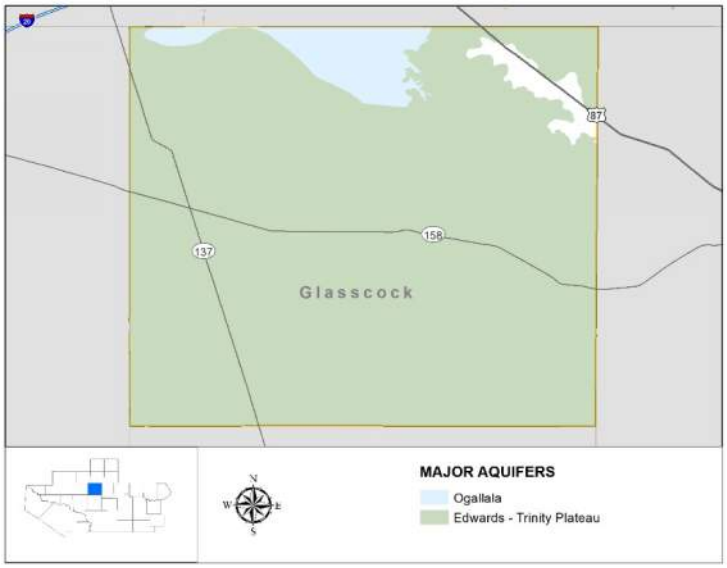
Ector County has projected shortages of over 15,000 acre-feet by 2070. All of these shortages are associated municipal use from Odessa, ECUD, and Greater Gardendale WSC. However, these can all be met through sales from Odessa, which receives subordinated supplies from CRMWD and other CRMWD system supplies.

Table 5E- 23
Ector County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Ector County UD	Sales from Odessa	Included in Odessa	Included in Odessa	Municipal Conservation See Odessa
Greater Gardendale WSC	Edwards-Trinity Plateau Aquifer	0	277	Municipal Conservation Purchase Water from Odessa
Odessa	See Major Water Providers Section			
County-Other	Edwards-Trinity Plateau Aquifer, Ogallala Aquifer, sales from Odessa, sales from Great Plains	0	0	None
Irrigation	Edwards-Trinity Plateau Aquifer, Ogallala Aquifer, sales from CRMWD, reuse sales from Odessa	None	None	Irrigation Conservation
Livestock	Livestock Local Supplies, Ogallala Aquifer, Edwards-Trinity Plateau, Pecos Valley Aquifer	None	None	None
Manufacturing	Reuse and Treated Water sales from Odessa, sales from Great Plains Edwards-Trinity Plateau Aquifer, Pecos Valley Aquifer, Dockum Aquifer	None	None	None
Mining	Reuse sales from Odessa, sales from Great Plains, Well Field Recycling, Edwards-Trinity Plateau Aquifer, Dockum Aquifer	None	None	Mining Conservation/Recycling
Steam Electric	Sales from Great Plains (Gaines and Andrews Co.), Sales from Odessa	0	0	None

5E.10 Glasscock County

Glasscock County has limited surface water and groundwater supplies. Some local surface water is used by livestock, but the nearly all water within Glasscock County is supplied from the Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer and Ogallala Aquifers. Most of the supply from these sources is nearly fully developed for current use. The largest water demand in Glasscock County is for irrigation, with demands at approximately 51,254 acre-feet from 2020 through 2070. Mining use is the second largest water user group, with demands of approximately 5,900 acre-feet in 2020 and 1,500 acre-feet in 2070.



In Glasscock County, groundwater supplies are sufficient to meet demands from all users throughout the planning horizon, so there were no identified water shortages. Irrigation conservation and mining conservation (recycling) were identified as viable means of preserving existing supplies and are recommended strategies. These strategies will meet the current needs within Glasscock County and are discussed in more detail in Chapter 5B. Municipal conservation was not recommended for Glasscock County-Other because there was no shortage.

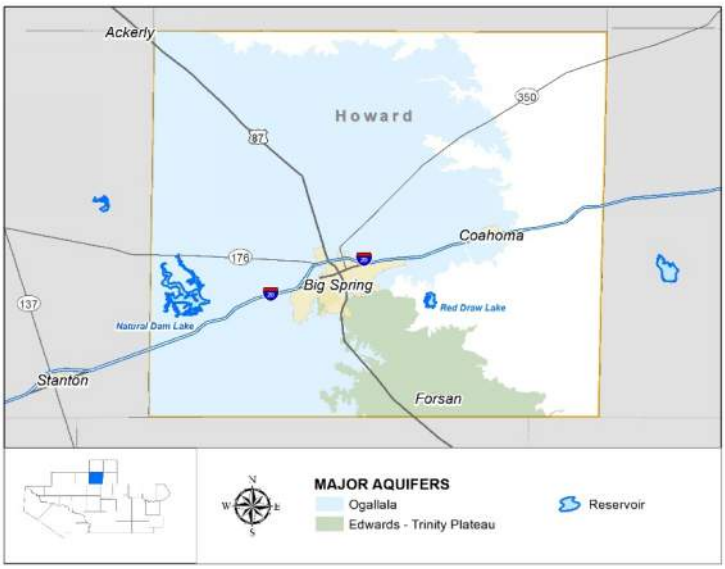
5E.10.1 Glasscock County Summary

Table 5E- 24
Glasscock County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
County-Other	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Irrigation	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer, Ogallala Aquifer	None	None	Irrigation Conservation
Livestock	Stock Ponds, Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer, Ogallala Aquifer	None	None	None
Manufacturing	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Mining	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer, Well Field Recycling	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.11 Howard County

A major source of supply for Howard County is CRMWD's system which supplies Big Spring and consequently, Coahoma, steam electric power, and manufacturing. The shortages for these users can be met through conservation and subordination of CRMWD's supplies. All other water users in Howard County are primarily reliant on groundwater from the Ogallala and Edwards-Trinity-High-Plains Aquifer and the Edwards-Trinity Plateau Aquifer. The Dockum Aquifer is also used as a supply by some County-Other, irrigation, livestock, and mining users. However, the Dockum tends to be brackish, limiting the amount and types of use without treatment. Treatment is not economically feasible for many small communities or for agricultural uses.



After considering conservation (municipal, irrigation and mining) and subordination of supplies from CRMWD, there is adequate water supply for all users in Howard County. However, a new treatment plant is necessary in Big Spring to treat these raw water supplies to meet current and potential future demands.

5E.11.1 Big Spring

The City of Big Spring is a CRMWD member city. CRMWD supplies one hundred percent of Big Spring and their customers' demand with raw water from their system. The City of Big Spring currently treats and sells water to retail customers within the city limits, Coahoma, steam electric power, and some manufacturing operations in Howard County. The projected needs for Big Spring and their customers can be fully met through conservation and subordination of CRMWD supplies. However, at these projected demand levels, the City will exceed its current water treatment plant capacity by 2020. A new water treatment plant is necessary to make the raw water supplies provided by CRMWD potable and fit for municipal use. The recommended strategies for Big Spring include municipal conservation, obtaining the contracted supplies from CRMWD and a new 20 MGD water treatment plant in 2020. The supplies shown in Table 5E-37 represent the amount of supplies Big Spring will receive from CRMWD to meet their need and their customer's needs.

Big Spring Recommended Strategies

- Municipal Conservation
- Subordination (CRMWD supplies)
- New Water Treatment Plant (20 MGD)

Potentially Feasible Strategies Considered for Big Spring:

- Municipal Conservation
- Subordination (CRMWD supplies)
- New Water Treatment Plant (20 MGD)

Table 5E- 25
Recommended Water Management Strategies for Big Spring

	Capital Cost	2020	2030	2040	2050	2060	2070
City of Big Spring		6,227	6,368	6,379	6,327	6,316	6,316
Treated Customer Demand		735	743	746	746	745	745
Raw Customer Demand		1,500	1,500	1,500	1,500	1,500	1,500
Future Raw Customer Demand		500	500	500	500	500	500
Total Demand		8,462	8,611	8,625	8,573	8,561	8,561
Existing Supply (Purchased from CRMWD)		7,632	8,611	8,625	7,695	6,890	6,141
Shortage		1,330	500	500	1,378	2,171	2,920
Recommended Strategies							
Municipal Conservation	$0	131	138	140	139	139	139
*WTP Expansion (20 MGD)**	*$104,651,000*	*1,330*	*500*	*500*	*1,378*	*2,171*	*2,920*
Subordination (CRMWD Supplies)	$0	1,330	500	500	1,378	2,171	2,920
TOTAL	**$104,651,000**	**1,461**	**638**	**640**	**1,517**	**2,310**	**3,059**

**This strategy is for infrastructure required to access the subordination supplies and is not included in the total to avoid double counting. The amount shown above is the supply available from the subordination strategy.*

5E.11.2 Howard County Summary

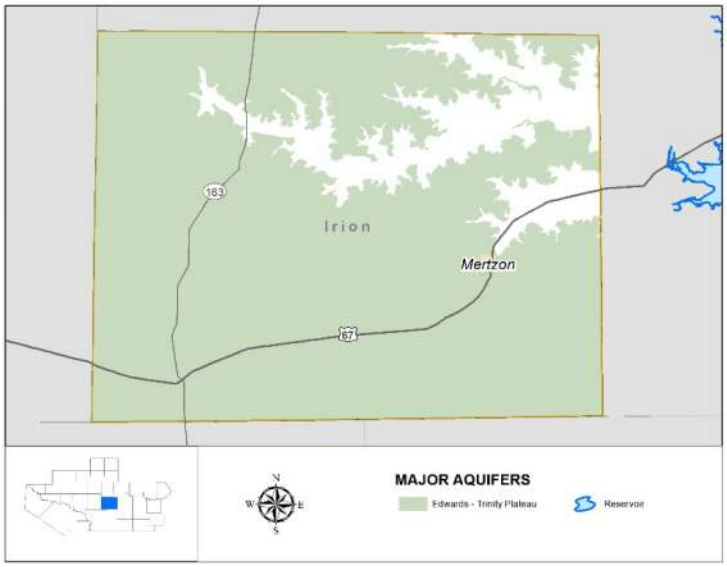
All shortages in Howard County are met when considering subordination of the supplies from CRMWD. For this supply to be fully utilized, Big Spring will need a new water treatment plant in 2020 to access their subordination supplies. Conservation is also recommended as a strategy for municipal, irrigation, and mining users.

Table 5E- 26
Howard County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Big Spring	Sales from CRMWD	830	2,420	Municipal Conservation Subordination of CRMWD supplies New WTP (20 MGD)
Coahoma	Sales from Big Spring	51	152	Municipal Conservation Obtain contractual supplies from Big Spring
County-Other	Ogallala Aquifer, Dockum Aquifer, Edwards-Trinity Plateau Aquifer	None	None	None
Irrigation	Ogallala Aquifer, Dockum Aquifer, Edwards-Trinity Plateau Aquifer	None	None	Irrigation Conservation
Livestock	Livestock Local Supplies, Ogallala Aquifer, Edwards-Trinity Plateau Aquifer, Dockum Aquifer	None	None	None
Manufacturing	Sales from Big Spring, Ogallala Aquifer, Edwards-Trinity Plateau Aquifer	147	424	Supplies from Big Spring
Mining	Brackish sales from CRMWD, Ogallala Aquifer, Dockum Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	Sales from Big Spring, Ogallala Aquifer	----		----

5E.12 Irion County

The majority of the water supply for Irion County is derived from the Edwards-Trinity Plateau Aquifer. In addition to this groundwater supply, mining users obtain some water from other aquifers in the county, such as the Dockum and Lipan. . Irrigators also have a small run-of-river supply and livestock has some local supplies. Current sources of supply are shown to be adequate to meet demands for all users throughout the planning horizon, except for irrigation and mining.



5E.12.1 Irion County Mining

Mining demands in Irion County have historically been met through the use of groundwater. However, the sharp increase in demands in early decades requires the development of additional groundwater supplies. In addition, the mining industry is actively pursuing recycling technologies to help meet its needs. For planning purposes, this is classified as mining conservation, and is considered as a recommended strategy. Conservation is discussed in further detail in Chapter 5B. The modeled available groundwater in Irion County is inadequate to meet the entire demand in early decades and there are few other options to meet the mining shortage. As a result, mining will have an unmet need. Mining is an exempt use and it is anticipated that mining users will continue to develop groundwater as needed, even if it exceeds the MAG.

5E.12.2 Irion County Irrigation

Irion County Irrigation has an unmet need. This need can be partially alleviated by conservation and weather modification strategies. Irion County lies within the West Texas Weather Modification Association program, where active precipitation enhancement is currently occurring. Both of these strategies are discussed in Chapter 5B.

Potentially Feasible Water Management Strategies Considered for Irion County Irrigation:

- Irrigation Conservation
- Weather Modification

Irion County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Weather Modification

The West Texas Weather Modification Association attributes an annual increase of 2.62 inches of rainfall over Irion County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 923 irrigated acres in Irion County,

implementation of this strategy is expected to save 202 acre-feet of water per year at a unit cost of $0.21 per acre-feet.

Table 5E- 27
Recommended Water Strategies for Irion County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		1,053	1,053	1,053	1,053	1,053	1,053
Existing Supply (Groundwater, Run-of-River Supply)		546	546	546	546	546	546
Shortage		507	507	507	507	507	507
Recommended Strategies							
Irrigation Conservation	$120,000	53	105	158	158	158	158
Weather Modification	$0	202	202	202	202	202	202
TOTAL	**$120,000**	**255**	**307**	**360**	**360**	**360**	**360**

5E.12.3 Irion County Summary

Needs in Irion County are associated with the mining and irrigation industries. In the early decades, the mining need is nearly 1,800 acre-feet. By 2050, the demand drops significantly and there is no projected shortage. There will be unmet needs for irrigation and mining, even after conservation measures, due to a lack of viable alternatives.

Table 5E- 28
Irion County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Mertzon	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer	None	None	Municipal Conservation
County-Other	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Irrigation	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer, Run-of-River	507	507	Irrigation Conservation Weather Modification
Livestock	Stock Ponds, Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Manufacturing	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Mining	Dockum Aquifer, Lipan Aquifer, Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifer, Well Field Recycling	1,766	0	Mining Conservation(Recycling)
Steam Electric	----	----	----	----

Table 5E- 29
Unmet Needs in Irion County
-Values are in Acre Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Irrigation	252	200	147	147	147	147
Mining	1,444	1,440	225	0	0	0

5E.13 Kimble County

Kimble County has limited groundwater and surface water supplies. Surface water supplies from the South Llano River are severely limited, even under subordination. Most of the groundwater in Kimble County is derived from the Edwards-Trinity Plateau aquifer. While there is some remaining availability shown for future groundwater development from this source, wells in this area often have low production rates and can be plagued with water quality issues. The majority of Kimble County's shortages are for irrigation and manufacturing. Manufacturing shortages are mainly due to artificially inflated demands caused by the difference in diversion rates and actual consumptive use. The City of Junction also has a municipal shortage due to limited supplies from their run-of-river right.

5E.13.1 Junction

The City of Junction obtains all of its supply from a run-of-river right on the South Llano River. Under strict priority, this right has no supply. In previous plans, the subordination strategy was enough to meet all of the City's needs. However, the drought has reduced the amount of reliable yield from subordination and other water management strategies must be considered to meet the shortage for the City of Junction.

Junction Recommended Strategies

- Municipal Conservation
- Dredge River Intake to Access Subordination Supplies
- Develop Edwards-Trinity Plateau Aquifer Supplies

Potentially Feasible Water Management Strategies Considered for Junction:

- Municipal Conservation
- Dredge River Intake to Access Subordination Supplies
- Develop Edwards-Trinity Plateau Aquifer Supplies

Dredge River Intake to Access Subordination Supplies

The City is considering dredging their river intake to ensure the ongoing use of their run-of-river supply by removing sedimentation and rocks that have built up over time. This project allows the City of Junction to fully access their subordination supply by increasing the City's storage capacity and improving accessibility to their surface water. This strategy is estimated to cost $7.5 million dollars assuming the dredged material is relatively clean and a suitable location for disposal of the waste material can be found nearby.

Develop Edwards-Trinity-Plateau Aquifer Supplies

Water from the Edwards-Trinity Plateau aquifer is not widely used because of low well yields in most areas. Some areas have poor water quality as well. However, there appears to be some areas within the county that have sufficient well yields for supplemental supplies to Junction. This strategy assumes that seven

new wells would be drilled to provide approximately 370 acre-feet per year. Water quality from this source is assumed to have elevated salts and would be blended with surface water. However, if it is determined that the water qualities of the two sources are incompatible, the groundwater may require advanced treatment. The capital cost is estimated at $3.3 million. Costs for advanced treatment are not included.

Table 5E- 30
Recommended Water Strategies for Junction

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		626	620	609	605	604	604
Existing Supply (Run-of-River Supply)		0	0	0	0	0	0
Shortage (ac-ft/yr)		626	620	609	605	604	604
Recommended Strategies(ac-ft/yr)							
Municipal Conservation		8	8	8	8	8	8
Subordination (Colorado Run-of-River Supply)	$0	250	250	250	250	250	250
*Dredge River Intake**	*$7,505,000*	*250*	*250*	*250*	*250*	*250*	*250*
Develop Edwards-Trinity-Plateau Aquifer Supplies	$3,634,000	370	370	370	370	370	370
TOTAL	**$11,139,000**	**628**	**628**	**628**	**628**	**628**	**628**

**This strategy is for infrastructure required to access the subordination supplies and is not included in the total to avoid double counting.*

5E.13.2 Kimble County Manufacturing

Manufacturing demand in Kimble County is dominated by Grayden Cedarworks. The cedar process plant currently diverts around 500-600 acre-feet per year but can only consume 50 acre-feet per year. The remainder of the diversions must be returned to the streams for downstream water-right holders. This difference in diversions and consumptive use artificially inflates the manufacturing demands in Kimble County. To address this discrepancy, the quantity of water that can reliably be diverted under subordination was assessed for the Gradyen Cedrworks water right. Additional information on subordination can be found in Chapter 5C.

Kimble County Manufacturing Recommended Strategies

- Subordination
- Develop Ellenburger San Saba Aquifer Supplies

Potentially Feasible Water Management Strategies Considered for Kimble County Manufacturing:

- Subordination
- Develop Ellenburger San Saba Aquifer Supplies

Develop Edwards-Trinity-Plateau Aquifer Supplies

Water from the Ellenburger San Saba aquifer is not widely used because of low well yields in most areas. Some areas have poor water quality as well. However, there appears to be some areas within the county that have sufficient well yields to meet manufacturing water needs. This strategy assumes that 10 new wells would be drilled to provide approximately 500 acre-feet per year. The capital costs for this strategy are estimated to be $0.94 million.

Table 5E- 31
Recommended Water Management Strategies for Kimble County Manufacturing

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		605	706	706	706	706	706
Existing Supply (Groundwater, Run-of-River Supply)		2	2	2	2	2	2
Shortage		603	704	704	704	704	704
Recommended Strategies							
Subordination	$0	228	228	228	228	228	228
Develop Ellenburger San Saba Aquifer Supplies	$1,621,000	500	500	500	500	500	500
TOTAL	**$1,621,000**	**728**	**728**	**728**	**728**	**728**	**728**

5E.13.3 Kimble County Summary

Irrigation and manufacturing account for most of the need in Kimble County, with the City of Junction showing a projected need of 626 acre-feet per year in 2020 and 604 acre-feet per year in 2070. All of Junction's needs can be met through conservation, subordination, dredging, and new groundwater. Manufacturing needs can also be met with subordination and new groundwater, but irrigation continues to show a shortage after strategies are implemented.

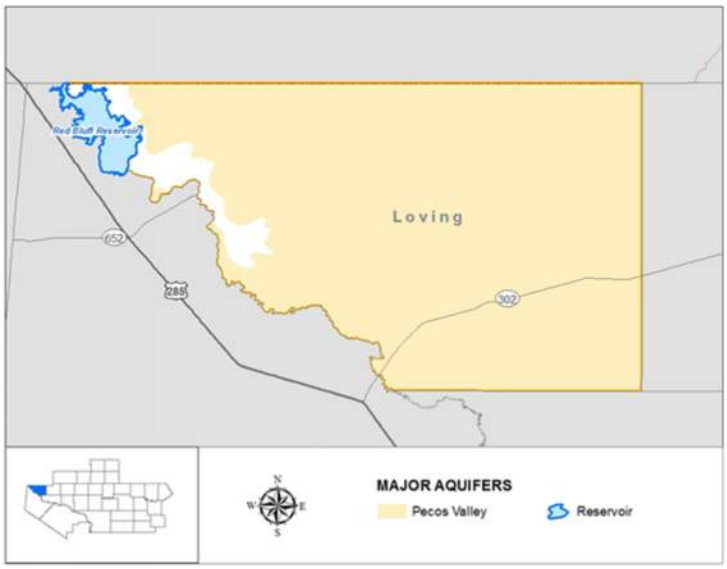
Table 5E- 32
Kimble County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Junction	Run-of-River	626	604	Municipal Conservation, Subordination, Develop Edwards-Trinity Aquifer, Dredging
County-Other	Edwards-Trinity Plateau	None	None	None
Irrigation	Edwards-Trinity Plateau Aquifer, Hickory Aquifer, Run-of-River	1,103	1,103	Irrigation Conservation
Livestock	Edwards-Trinity Plateau, Livestock Local Supplies	None	None	None
Manufacturing	Run-of-River, Edwards-Trinity Plateau Aquifer	603	704	Develop Additional Edwards Trinity Plateau Aquifer Supplies, Subordination
Mining	Edwards-Trinity Plateau Aquifer, Run-of-River	None	None	Mining Conservation (Recycling)
Steam Electric	----	----		----

Table 5E- 33
Unmet Needs in Kimble County
-Values are in Acre Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Irrigation	970	837	784	784	784	784

5E.14 Loving County



Loving County is solely reliant on local groundwater sources to supply its water users, including the Pecos Valley, Dockum, and Rustler Aquifers. Most demands in the county are relatively small (less than 50 ac-ft) and can be met with these supplies. However, mining water demands are projected to be as much as 7,500 acre-feet per year in 2020 due to the recent, rapid growth in oil and gas production. Due to the limited groundwater supplies available in Loving County, water shortages were identified for mining users throughout the planning horizon. The only recommended strategy in Loving County is conservation/recycling for mining. This strategy is discussed in detail in Chapter 5B. Mining users will still show an unmet need after conservation due to the limited groundwater availability the county. Since mining is an exempt use, it is likely mining will continue to rely on and develop groundwater, even if it exceeds the MAG.

5E.14.1 Loving County Summary

Table 5E- 34
Loving County Summary

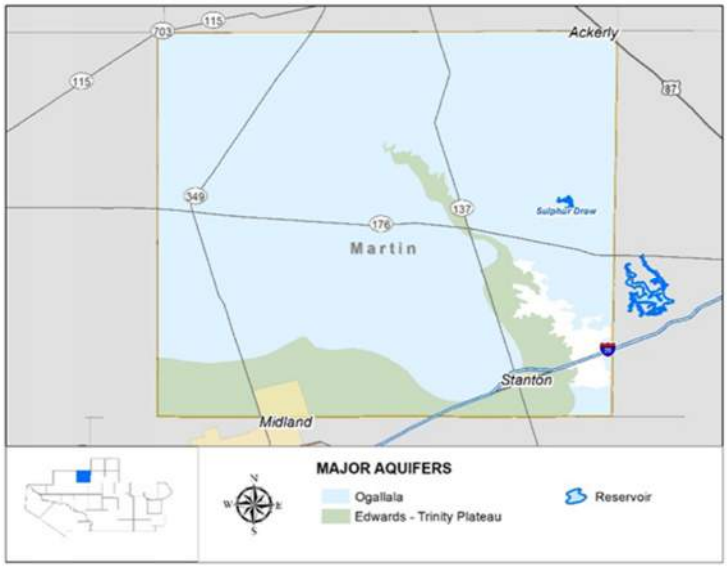
Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
County-Other	Edwards-Trinity-Plateau and Pecos Valley Aquifer	None	None	None
Irrigation	----	----	----	----
Livestock	Livestock Local Supplies, Edwards-Trinity-Plateau and Pecos Valley Aquifer, Dockum	None	None	None
Manufacturing	----	----	----	----
Mining	Edwards-Trinity-Plateau and Pecos Valley Aquifer	3,906	1,000	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

Table 5E- 35
Unmet Needs in Loving County
-Values are in Acre Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Mining	3,381	3,381	2,543	1,427	699	762

5E.15 Martin County

Martin County has limited surface water and groundwater supplies. Groundwater from the Ogallala and Edwards-Trinity High Plains Aquifers is the primary source for most water users. In early decades, this source is shown to have supplies in excess of demands. However, the MAG availability decreases significantly over time, resulting in shortages for irrigators beginning in 2050. Other local groundwater sources include the Dockum and Edwards-Trinity Plateau Aquifers, which have diminished water quality and are not currently used in Martin County. Outside of groundwater, Stanton purchases water from CRMWD and mining receives wastewater reuse supplies from Odessa and Midland.



Beginning in 2050, there are shortages in Martin County associated irrigation are due to the limited amount of available groundwater under the MAG. The City of Stanton is also shown to have a shortage from 2050 – 2070, however, this shortage is met through subordination of CRMWD's supplies.

5E.15.1 Martin County Summary

Martin County has a total projected shortage of nearly 5,000 acre-feet per year by 2070. Most of these shortages are associated with the limitations of the supplies from the Ogallala and Edwards-Trinity-High-Plains Aquifers based on the adopted MAGs. Irrigation shortages deepen despite conservation due to Midland's strategy to use additional supplies from the Paul Davis well field that is partially located in Martin County. The remaining shortage in Martin County is associated with Stanton, receives subordination supplies from CRMWD and can municipal conservation strategies to meet its needs.

Table 5E- 36
Martin County Summary

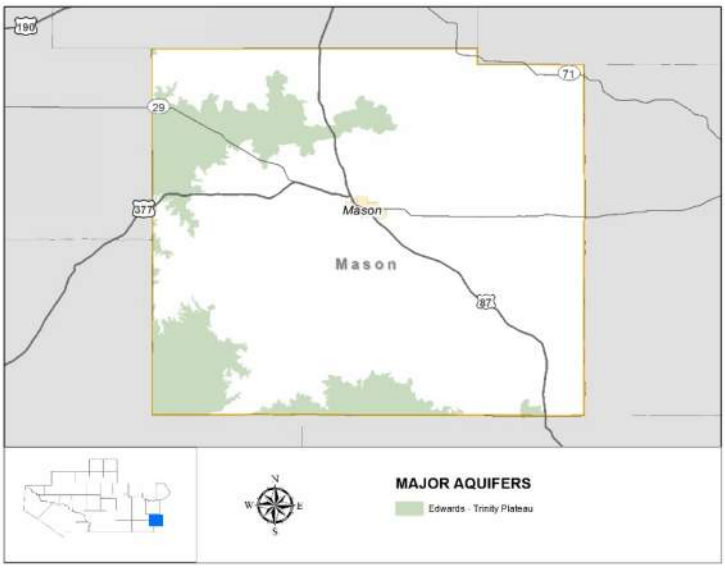
Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Strategies
Stanton	Run-of-River, Direct Reuse, Ogallala and Pecos Aquifers	0	90	Municipal Conservation Subordination
County-Other	Ogallala Aquifer	None	None	None
Irrigation	Ogallala Aquifer	0	4,729	Irrigation Conservation
Livestock	Ogallala Aquifer, Livestock Local Supplies	None	None	None
Manufacturing	Ogallala Aquifer	None	None	None
Mining	Ogallala Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

Table 5E- 37
Unmet Needs in Martin County
-Values are in Acre-Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Irrigation	0	0	2,392	3,346	6,004	7,844

5E.16 Mason County

Mason County is dependent on groundwater supplies from the Hickory, Marble Falls, Ellenburger-San Saba, and undifferentiated other Aquifers. The only need identified over the planning horizon in Mason County is for the City of Mason. The City of Mason has experienced issues related to quality and will need to pursue additional treatment to be in compliance with TCEQ regulations. Conservation is recommended for the City of Mason, as well as for irrigation and mining users to preserve water for future and other uses. Conservation is discussed in detail in Chapter 5B. Conservation is not recommended for County-Other since there is no water shortage. Table 5E- 62 shows a summary of supplies, shortages and recommended strategies for Mason County.



5E.16.1 Mason

The City of Mason is supplied by groundwater from the Hickory aquifer. While there is enough volume of groundwater available, the water quality suffers due to naturally occurring radioactive materials and the supply exceeds the Maximum Contaminant Level (MCL) for gross alpha particles. Consequently, additional treatment will be necessary for Mason to continue to use this source.

Mason Recommended Strategies

- Municipal Conservation
- Additional Water Treatment

Potentially Feasible Water Management Strategies Considered for Mason:

- Municipal Conservation
- Additional Water Treatment

Additional Water Treatment

Mason is actively pursuing the development of a hydros manganese oxide (HMO) treatment system to remove radium-226 and -228 from their water supply and become compliant with the MCL. The City has already received funding from the TWDB and working on implementation.

Table 5E- 38
Recommended Water Management Strategies for Mason

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		700	690	682	677	676	676
Supply (Groundwater)		0	0	0	0	0	0
Shortage (ac-ft/yr)		700	690	682	677	676	676
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	7	7	7	7	7	7
Additional Water Treatment	$2,605,000	700	690	682	677	676	676
TOTAL	**$2,605,000**	**707**	**697**	**689**	**684**	**683**	**683**

5E.16.2 Mason County Summary

Table 5E- 39
Mason County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Mason	Hickory Aquifer	700	676	Municipal Conservation Additional Water Treatment
County-Other	Ellenburger-San Saba Aquifer, Hickory Aquifer, Other Aquifer	None	None	None
Irrigation	Hickory Aquifer	None	None	Irrigation Conservation
Livestock	Livestock Local Supplies, Ellenburger-San Saba Aquifer, Hickory Aquifers	None	None	None
Manufacturing	----	----	----	----
Mining	Hickory Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.17 McCulloch County

McCulloch County has limited surface water and groundwater supplies. Some surface water is used from Lake Brady and CRMWD sources for the City of Brady and Millersview Doole WSC, respectively. Water quality from Lake Brady and the Hickory Aquifer is impaired and either requires advanced treatment or blending with a high quality source for municipal use. Groundwater from the Hickory and Ellenburger-San Saba aquifers are the primary sources for other water users. The only shortage identified in McCulloch County is for the City of Brady. When subordination of the Brady Creek Reservoir is considered, Brady can blend their surface water supplies with their groundwater supplies to achieve acceptable water quality levels and a total supply to meet their demands. Conservation strategies are also identified for municipal (Brady, Millersview-Doole WSC, Richland SUD), irrigation and mining users. These strategies are discussed in Chapter 5B.

5E.17.1 Brady

The City of Brady obtains water from groundwater wells in the Hickory aquifer and surface water from Brady Creek Reservoir. The City has capacity to produce about 1,200 acre-feet of groundwater per year. The groundwater is used conjunctively with their surface water, so in some years the City may rely heavily on groundwater and exceed this amount; in other years they may use little to no groundwater. To address surface water quality concerns, the City constructed one of the first membrane filtration treatment plants in Texas for water from Brady Creek Reservoir in 2000. Water from the reservoir was then blended with Hickory groundwater to reduce radium levels. Brady Creek Reservoir has no supplies under WAM Run 3 but subordination does show supplies. While these subordinated supplies may be available in some years, drought has severely impacted Brady Creek Reservoir and the supply is not always reliable. Without surface water supplies to blend with the Hickory supplies, the City is above the TCEQ requirements for radionuclides and gross alpha particles. In order to conjunctively use the supplies made available through subordination with groundwater from the Hickory, new advanced treatment will be required. The recommended strategies for Brady are municipal conservation, subordination and advanced treatment. Conservation and subordination are discussed in Chapters 5B and 5C respectively.

Brady Recommended Strategies

- Municipal Conservation
- Subordination (Brady Creek Reservoir)
- Advanced Groundwater Treatment

Potentially Feasible Water Management Strategies Considered for the City of Brady:

- Municipal Conservation
- Subordination (Brady Creek Reservoir)
- Advanced Groundwater Treatment

Advanced Groundwater Treatment

To address water quality issues when surface water from Brady Creek Reservoir is not available, the City plans to pursue the development of an advanced groundwater treatment facility to come into compliance with TCEQ water quality requirements. This facility is sized to treat the full capacity of Brady's groundwater well field (1,200 acre-feet per year).

Table 5E- 40
Recommended Water Strategies for Brady

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		1,396	1,425	1,407	1,415	1,417	1,419
Supply (Surface Water, Groundwater)		0	0	0	0	0	0
Shortage (ac-ft/yr)		1,396	1,425	1,407	1,415	1,417	1,419
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	18	18	19	19	19	19
Subordination (Brady Creek Reservoir)	$0	841	841	841	841	841	841
Advanced Groundwater Treatment	$29,719,000	1,200	1,200	1,200	1,200	1,200	1,200
TOTAL	**$29,719,000**	**2,059**	**2,059**	**2,060**	**2,060**	**2,060**	**2,060**

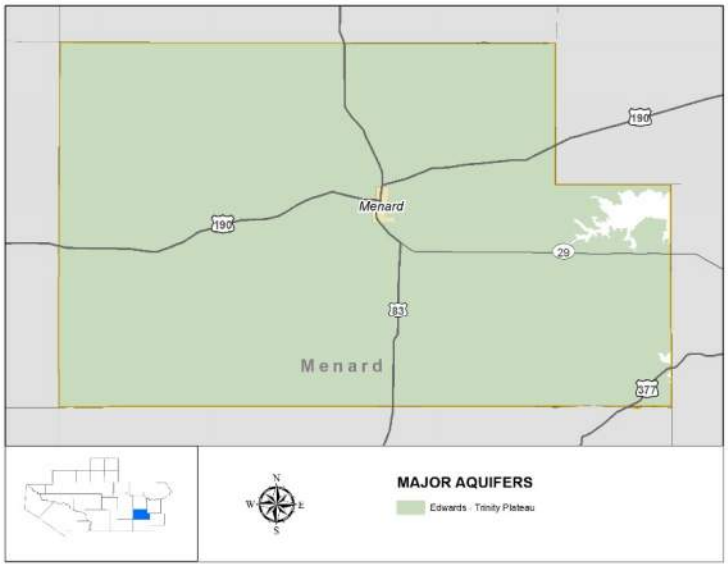
5E.17.2 McCulloch County Summary

The total need for McCulloch County is projected to be around 1,400 acre-feet per year throughout the planning horizon. This shortage is primarily due to the City of Brady's groundwater quality and lack of firm supplies in the Brady Creek Reservoir. However, when considering subordination of the Brady Creek Reservoir, when Brady can blend their groundwater with surface water to achieve an acceptable water quality and have enough supplies to meet their needs. However, since the surface water supplies can be unreliable during drought conditions, additional advanced treatment is recommended so that the City has adequate supplies that meet drinking water standards when they must rely solely on groundwater. Conservation strategies are also recommended for municipal, mining, and irrigation users, which will decrease the reliance on current water supplies. These strategies are discussed further in Chapter 5B.

Table 5E- 41
McCulloch County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Strategies
Brady	Brady Reservoir, Hickory Aquifer	1,396	1,419	Municipal Conservation, Subordination, Treatment
Millersview-Doole WSC	CRMWD Supplies, Hickory Aquifer	None	None	Municipal Conservation, Subordination (CRMWD supplies)
Richland SUD	Ellenburger-San Saba Aquifer, Marble Falls Aquifer	None	None	Municipal Conservation
Irrigation	Run-of-River, Hickory Aquifer, Marble Falls Aquifer	None	None	Irrigation Conservation
County-Other	Hickory Aquifer, Other Aquifer, Sales from Brady	None	None	None
Livestock	Edwards-Trinity Plateau, Ellenburger-San Saba, Hickory, Marble Falls Aquifer, Other Aquifer, Local Supplies	None	None	None
Manufacturing	Hickory Aquifer, Edwards-Trinity Plateau Aquifer	None	None	None
Mining	Ellenburger-San Saba Aquifer, Hickory Aquifer	None	None	Mining Conservation/Recycling
Steam Electric	--	--	--	----

5E.18 Menard County



Water users in Menard County obtain their water supplies from the San Saba River and local groundwater, including the Ellenburger-San Saba and Edwards-Trinity Plateau aquifers. The Hickory aquifer also underlies Menard County, but it is not currently used due to the depth of the formation and presence of radionuclides. The ongoing drought has reduced the reliability of the county's surface water supplies, resulting in shortages for the City of Menard.

5E.18.1 Menard

The City of Menard has several wells near the banks of the San Saba River that produce water from the San Saba River Alluvium. Reduced flows in the San Saba River during a severe drought have the potential to reduce the City's available supply. For the purposes of this plan, supplies for the City of Menard are considered to be surface water. However, recent actions by state agencies have re-classified the City's supply as groundwater. Based on the Colorado WAM through 2013, Menard is shown to have a shortage of about 200 acre-feet per year under drought of record conditions.

During the recent drought the City relied on water conservation and drought management to prevent shortages. Although this strategy proved successful, the City desires to increase the reliability of its supplies by developing a groundwater source. The City is currently considering developing a well in the Hickory aquifer. In addition, the City is interested in developing a direct reuse project for agricultural irrigation of the City Farm.

Previously Evaluated and Dismissed Water Management Strategies:

- San Saba Off-Channel Reservoir

Potentially Feasible Water Management Strategies Considered for Menard:

- Direct Non-Potable Reuse
- Develop Hickory Aquifer Supplies

Menard Recommended Strategies

- Municipal Conservation
- Direct Non-Potable Reuse
- Develop Hickory Aquifer Supplies

Direct Non-Potable Reuse

The City is interested in developing a direct reuse project for agricultural irrigation of the City Farm. This strategy assumes that the current WWTP will need to construct the necessary improvements in order to bring a portion of the plant's effluent to Type 1 standards. This strategy will cost approximately $700,000 and will yield 67 additional acre-feet per year.

Develop Hickory Aquifer Supplies

The City is planning to drill one well near its existing storage tank to provide approximately 200 acre-feet per year. This strategy assumes that the source can be blended with the City's other sources to meet safe drinking water standards. This strategy will cost approximately $3.3 million and will yield 200 additional acre-feet per year.

Table 5E- 42
Recommended Water Strategies for Menard

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		350	342	336	335	335	335
Supply (Run-of-River Supply)		139	139	139	139	139	139
Shortage (ac-ft/yr)		211	203	197	196	196	196
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	5	5	5	5	5	5
Reuse	$696,500	67	67	67	67	67	67
Develop Hickory Aquifer Supplies	$3,287,000	200	200	200	200	200	200
TOTAL	**$3,983,500**	**272**	**272**	**272**	**272**	**272**	**272**

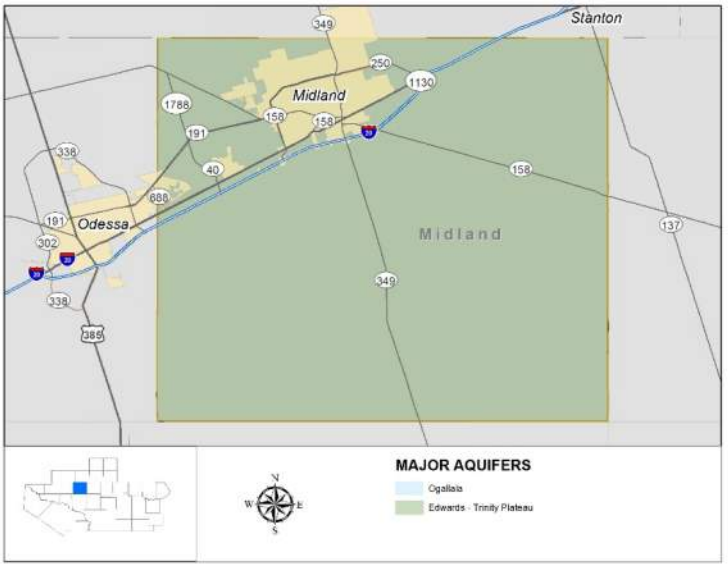
5E.18.2 Menard County Summary

Menard County is projected to have a shortage of 211 acre-feet per year in 2020 and 196 acre-feet per year in 2070. This shortage is associated with the City of Menard. The City can meet its projected needs with the recommended water management strategies. Conservation is also recommended for Mining despite there being no shortage. County-Other, Livestock and Manufacturing show no shortages and have no recommended strategies.

Table 5E- 43
Menard County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Menard	River wells	211	196	Municipal Conservation, Hickory Aquifer, Direct Non-Potable Reuse
County-Other	Edwards-Trinity, Ellenburger-San Saba, and Other Aquifers	None	None	None
Irrigation	Run-of-River	None	None	Irrigation Conservation
Livestock	Livestock Local Supplies, Edwards-Trinity, Ellenburger-San Saba, and Other Aquifers	None	None	None
Manufacturing	Sales from Menard	None	None	None
Mining	Edwards-Trinity and Ellenburger-San Saba Aquifers	None	None	Mining Conservation/Recycling
Steam Electric	----	----	----	----

5E.19 Midland County



Midland County has experienced high population growth in recent years due to the increased interest in oil and gas exploration in the region. Most of the water supply for Midland County comes from sales from the CRMWD system or groundwater. The only shortages in Midland County are associated with the City of Midland. The City of Midland is classified as a major water provider and is discussed in Chapter 5D. While there are no identified needs for County Other, several local providers are planning new projects to serve the growing rural communities. Conservation is recommended for irrigation and mining users, despite there being no shortage for either user. Details on all conservation strategies may be found in Chapter 5B. Livestock and manufacturing show no shortages and have no recommended strategies.

5E.19.1 Midland County Other

Midland County-Other currently obtains water from local groundwater aquifers, including the Ogallala and Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifers. The plan assumes that these users will continue to obtain water from these sources to meet the projected demands and Midland County Other shows no shortage. However, Midland County Utility District (which is included in Midland County other) is considering developing additional groundwater in conjunction with the Midland County Fresh Water District (FWD) from the Roark Ranch property. This strategy would expand groundwater supplies from the Pecos Valley aquifer in Winkler County and would be transported by the Midland County FWD pipeline to the greater Midland area. This strategy is a recommended strategy for Midland County Utility District (County Other).

Midland County Other Recommended Strategies

- Develop Pecos Valley Aquifer Supplies from Roark Ranch in Winkler County

Potentially Feasible Water Management Strategies Considered for Midland County Other:

- Develop Pecos Valley Aquifer Supplies from Roark Ranch in Winkler County

Develop Pecos Valley Aquifer Supplies from Roark Ranch in Winkler County

For planning purposes, the strategy was assumed to provide up to 2,800 acre-feet of additional water to County-Other in Midland County. It is assumed that 15 new wells would be drilled in Winkler County and connected to the existing T-Bar infrastructure, if agreements can be reached with the Midland County FWD and the City of Midland to provide this capacity in the transmission line from the T-Bar Well Field. For this strategy, no treatment is included. This supply is considered reliable, but the use of the T-Bar infrastructure may limit the supplies when Midland is using the full capacity of the system. The capital cost of this strategy is $24.6 million, not including the purchase of the groundwater rights which is considered complete for the purposes of this plan.

Table 5E- 44
Recommended Strategies for Midland County-Other

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		3,253	3,506	3,689	4,050	4,441	4,819
Supply (Groundwater)		3,253	3,506	3,689	4,050	4,441	4,819
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Develop Pecos Valley Aquifer Supplies from Roark Ranch in Winkler Co.	$24,557,000	2,800	2,800	2,800	2,800	2,800	2,800
TOTAL	**$24,557,000**	**2,800**	**2,800**	**2,800**	**2,800**	**2,800**	**2,800**

5E.19.2 Midland County Summary

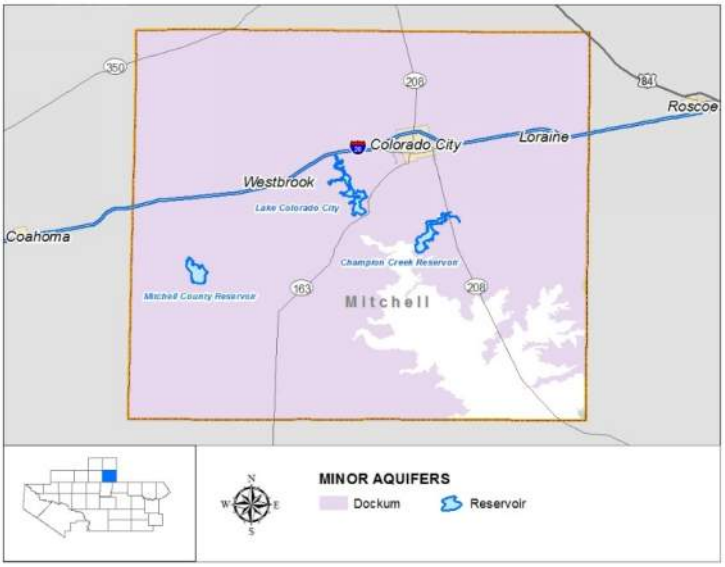
The total need for Midland County is projected to be around 18,700 acre-feet per year by 2070, which is all associated with the City of Midland. Some of this need will be met with conservation and subordination, but the City of Midland is pursuing other sources of water for development to close the remaining gap. One of these strategies is the West Texas Water Partnership, which is estimated to provide 15,000 acre-feet per year to the City. The details of this strategy were not available for the publication of the Initially Prepared Region F Plan but are anticipated to be included in the final version of the Region F plan. Another strategy includes advanced treatment and additional use of water from Midland's Paul Davis well field. Additional information on the City of Midland and their strategies can be found in Chapter 5D.

Table 5E- 45
Midland County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Airline Mobile Home Park LTD	Edwards-Trinity Plateau, Pecos Valley, and Trinity and Ogallala Aquifers	None	None	Municipal Conservation
Greenwood Water	Ogallala Aquifer	None	None	Municipal Conservation
Greater Gardendale WSC	See Section 5E.9 for Ector County			
Midland	See Chapter 5D for Major Water Providers			
Odessa	See Chapter 5D for Major Water Providers			
County-Other	Edwards-Trinity Plateau, Pecos Valley, and Trinity and Ogallala Aquifers	None	None	Develop Pecos Valley Aquifer Supplies from Roark Ranch in Winkler Co.
Irrigation	Edwards-Trinity Plateau, Pecos Valley, and Trinity and Ogallala Aquifers	None	None	Irrigation Conservation
Livestock	Livestock Local Supplies, Edwards-Trinity Plateau, Pecos Valley, and Trinity and Ogallala Aquifers	None	None	None
Manufacturing	Sales from Midland, Edwards-Trinity Plateau, Pecos Valley, and Trinity and Ogallala Aquifers	None	None	None
Mining	Edwards-Trinity Plateau, Pecos Valley, and Trinity and Ogallala Aquifers, Reuse, Well Field Recycling	None	None	Mining Conservation (Recycling)
Steam Electric	----	----		----

5E.20 Mitchell County

Most of the water users in Mitchell County obtain their water supplies from the Dockum aquifer. The only current surface water supply sources are a small amount of run-of river supplies used for irrigation and the Champion Creek/ Lake Colorado City system, which is used for cooling for a power plant. Mitchell County Reservoir is a brackish lake that is part of the CRMWD diverted water system. Colorado City, irrigation, and steam electric power were all identified with a shortage.



5E.20.1 Colorado City

Colorado City supplies their own municipal retail customers, manufacturing, and Westbrook (Mitchell County Other). Colorado City obtains its water from the Dockum aquifer. The City had 11 active wells with a production capacity of about 2,100 gpm. As water levels decline over time, the capacities also declined. During the last drought, the well field had difficulty in meeting the City's demands. As a result, the City added two wells to increase their system capacities and maintain sufficient supplies during drought. However, one of the new wells produces water high in sulfides and requires blending before use. There are also concerns related to possible oil field contamination. Therefore, Colorado City is planning to pursue additional wells. However, supply from Dockum in Mitchell County is limited by the MAG. Therefore, the well field expansion strategy is recommended as an alternate strategy until such time that the MAGs increase.

FGE Power (part of the steam electric power demand in Mitchell County) has potential plans to develop two new combined cycle gas turbine facilities in Mitchell County. The plans have been delayed numerous times and at the writing of this plan, it is unclear if or when these facilities may come online. In the event FGE moves forward with the construction of their plant, Colorado City plans to sell their wastewater supplies to FGE. This is included in the Region F plan as a strategy for SEP.

Potentially Feasible Water Management Strategies Considered for Colorado City:

- Municipal Conservation
- Dockum Well Field Expansion

Colorado City Recommended Strategies

- Municipal Conservation
- Dockum Well Field Expansion is considered Alternative due to MAG limitations

Table 5E- 46
Recommended Water Strategies for Colorado City

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		1,342	1,475	1,486	1,497	1,510	1,525
Supply (Groundwater)		1,342	1,342	1,342	1,342	1,342	1,342
Shortage (ac-ft/yr)		0	133	144	155	168	183
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	16	18	18	18	18	19
Alternative Strategies (ac-ft/yr)							
Dockum Well Field Expansion	$3,744,000	170	170	170	170	170	170

Alternate Water Management Strategies for Colorado City:

- Dockum Well Field Expansion

Dockum Well Field Expansion

This strategy's total capital costs amount to $3.7 million and could potentially yield 170 acre-feet of additional water per year. This strategy's total cost includes the construction of 2 new wells and the necessary piping infrastructure. However, the supply volume exceeds the current MAG in the Dockum aquifer. This strategy is not currently recommended but should be considered for future supplies should the DFC and MAG change in future planning cycles.

5E.20.2 Mitchell County Steam Electric Power

Luminant's Morgan Creek Power Plant is located in Mitchell County and obtains water from the Lake Colorado City – Champion Creek Reservoir system, which only has available supply under subordination. There are also two proposed facilities, FGE I and II, that are included in the steam electric power demand in Mitchell County. The proposed facilities would be combined cycle gas turbine plants, which tend to use less water than conventional power generation. However, these facilities are speculative and do not yet exist. The development of these facilities will depend on market conditions and other economic factors. If FGE does develop a new power plant in Mitchell County, they plan to purchase reuse supplies from the City of Colorado City's wastewater plant. This is included as a recommended strategy for SEP in Mitchell County. However, SEP still has a significant projected shortage, even after subordination and reuse. The options to meet this need are limited since there is little available groundwater in the county that is not already being used by another entity. Therefore, the remainder of the need remains unmet. However, some of this need may never come to fruition if FGE does not move forward with the two new facilities.

Potentially Feasible Water Management Strategies Considered for Mitchell County steam electric power:

- Subordination (Lake Colorado City/Champion Lake)
- Sale of Wastewater Effluent from Colorado City

Mitchell County Steam Electric Power Recommended Strategies

- Subordination (Lake Colorado City/Champion Lake)
- Sale of Wastewater Effluent from Colorado City

Sale of Wastewater Effluent from Colorado City

Colorado City plans to sell their wastewater effluent to FGE Texas Power I to use as cooling water for a new power plant. It assumed no upgrades to the City's wastewater plant are needed to implement this strategy. A 10-inch, 10-mile pipeline and associated pump stations and storage are assumed.

Table 5E- 47
Recommended Water Strategies for Mitchell County Steam Electric Power

	Capital Cost (millions)	2020	2030	2040	2050	2060	2070
Demand		10,326	10,326	10,326	10,326	10,326	10,326
Supply (Champion Lake)		0	0	0	0	0	0
Shortage (ac-ft/yr)		10,326	10,326	10,326	10,326	10,326	10,326
Recommended Strategies (ac-ft/yr)							
Subordination (Champion Lake)	$0	1,170	1,156	1,142	1,128	1,114	1,100
Reuse Sales from Colorado City	$8,642,000	500	500	500	500	500	500
TOTAL	**$8,642,000**	**1,670**	**1,656**	**1,642**	**1,628**	**1,614**	**1,600**

5E.20.3 Mitchell County Summary

Mitchell County is projected to have a shortages associated with users in Colorado City, steam electric power, and irrigation. Colorado City can meet its municipal needs after developing additional groundwater supplies, though this cannot be fully represented in the regional plan due to MAG limitations. Steam electric power has a large unmet need associated with a speculative demand for two new CCGT plants that may or may not be developed. Irrigation also has an unmet need despite conservation. Conservation is also recommended for mining despite there being no shortage. County-Other, livestock, manufacturing, and mining show no shortages and have no recommended strategies.

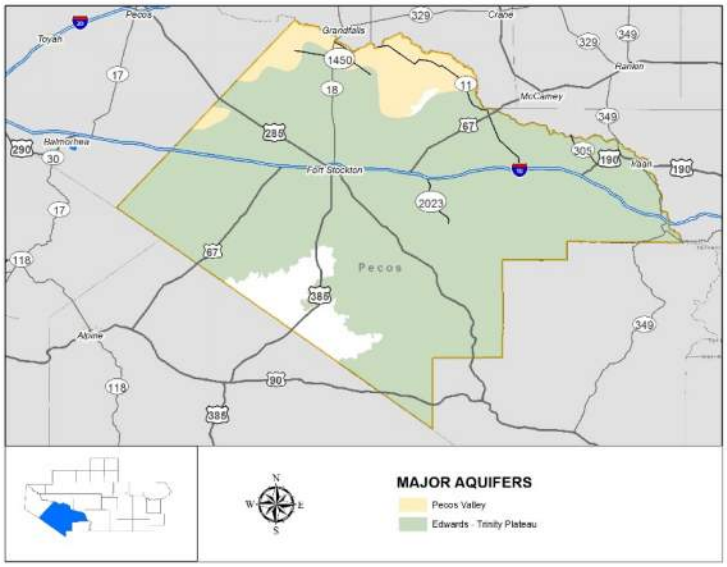
Table 5E- 48
Mitchell County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Colorado City	Dockum Aquifer	0	183	Municipal Conservation
Loraine	Dockum Aquifer	None	None	Municipal Conservation
Mitchell County Utility	Dockum Aquifer	None	None	Municipal Conservation
County-Other	Dockum Aquifer, Sales from Colorado City	None	None	None
Irrigation	Run-of-River, Dockum Aquifer	1,584	1,482	Irrigation Conservation
Livestock	Livestock Local Supplies, Dockum and Other Aquifers	None	None	None
Manufacturing	Purchase from Colorado City	None	None	None
Mining	Dockum Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	Champion Lake	10,326	10,326	Subordination, Reuse Sales from Colorado City

Table 5E- 49
Unmet Needs in Mitchell County
-Values are in Acre-Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Colorado City	0	115	126	137	150	164
Irrigation	1,328	1,602	1,507	1,389	1,310	1,226
Steam Electric Power	8,656	8,670	8,684	8,698	8,712	8,726
TOTAL	**9,984**	**10,388**	**10,317**	**10,224**	**10,172**	**10,117**

5E.21 Pecos County



Pecos County relies predominantly on groundwater to meet its water needs. Pecos County is split between two Groundwater Management Areas (GMAs 3&7) and therefore has two modeled available groundwater (MAG) values. Combined, the Edwards-Trinity Plateau/Pecos Valley aquifer system has over 240,000 acre-feet of modeled available groundwater. While the MAG value does not direct correspond to permit limits, the Middle Pecos Groundwater District, which is responsible for managing the aquifer to meet the Desired Future Conditions, has already issued permits in excess of 265,000 acre-feet. Historically, the permit holders have used significantly less than the permitted volume but theoretically could use the entire volume in any given year. There are other districts in Texas who have also permitted larger volumes than the MAG for some aquifers. And similar to Pecos County GCD, the historical pumping in those districts is also less than the MAG. Permits in the Rustler aquifer very slightly exceed the MAG and historical use has been near the permitted amount. The Capitan Reef and Dockum aquifers have both permitted and MAG availability, as shown in the table below.

Table 5E- 50
Modeled Available Groundwater, Permit Authorizations, and Historical Groundwater Use in Pecos Co.

Aquifer	GMA	MAG (acre-feet per year)	Permit Authorizations (ac-ft/yr)	Highest Historical Production (2014-2018) (ac-ft/yr)
Edwards-Trinity-Plateau and Pecos Valley Aquifers	3	122,899	146,978	46,567
Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers	7	117,309	120,205	71,554
Edwards-Trinity Pecos Valley Subtotal		***240,208***	***267,183***	***118,121***
Capitan Reef	3	4	1,796	564
Capitan Reef	7	26,164	3,347	1,536
Capitan Reef Subtotal		***26,168***	***5,143***	***2,100***
Dockum	3	6,142	0	0
Dockum	7	2,022	0	0
Dockum Subtotal		***8,164***	***0***	***0***
Rustler	3	2,378	2,378	2,378
Rustler	7	7,040	7,291	6,963
Rustler Subtotal		***9,418***	***9,669***	***9,341***

Several water user groups and major water providers in Region F have identified water supplies from Pecos County as an Alternative Water Management Strategy. It may be infeasible to develop all of these strategies, but some subset of them may be considered for implementation if an entity's recommended water management strategies were to become infeasible. However, it is beyond the scope of regional water planning to assess all of the legal, regulatory, and political facets of each Alternative Water Management Strategy.

There are limited surface water supplies within the county, which are used for irrigation purposes. Shortages within the county were identified for manufacturing and mining, which are both supplied by the City of Fort Stockton. Fort Stockton is classified as major water provider and is discussed in Chapter 5D. In addition, Pecos County WCID #1 expressed interest in developing specific water management strategies to increase the reliability of its supplies by diversifying their sources. Conservation is a recommended strategy for municipal, irrigation and mining use to help preserve the groundwater supplies for future use. Municipal conservation was not specifically recommended for Pecos County Other because there are no needs.

5E.21.1 Pecos County WCID #1

Pecos County WCID #1 obtains water from the Edwards Trinity Plateau aquifer. Although no shortages were identified, developing additional groundwater supplies is a recommended strategy to increase the reliability of the WCID's current system. For this planning purpose, it is assumed that Pecos County WCID #1 will drill additional wells in the Edwards-Trinity Plateau aquifer to back up current supplies.

Potentially Feasible Water Management Strategies Considered for Pecos County WCID #1:

- Develop Edwards-Trinity Plateau Aquifer Supplies
- Transmission Pipeline Replacement

Pecos County WCID #1 Recommended Strategies

- Municipal Conservation
- Develop Edwards-Trinity-Plateau Aquifer Supplies
- Transmission Pipeline Replacement

Develop Edwards-Trinity-Plateau Aquifer Supplies

This strategy assumes that two new wells will be drilled and could supply up to 250 acre-feet per year. The capital costs for the wells are estimated at $3.6 million. Associated transmission costs are included as a separate strategy (see "Transmission Pipeline Replacement" below).

Transmission Pipeline Replacement

A replacement 18-inch, 20-mile transmission pipeline is included to bring the existing supplies and supplies from water management strategies to Pecos County WCID #1's distribution system. This pipeline, which would be used to transport all of the WCID's supplies, is estimated to cost $26.1 million.

Table 5E- 51
Recommended Water Strategies for Pecos County WCID #1

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		384	398	415	433	453	472
Supply (Groundwater)		384	398	415	433	453	472
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	9	10	11	11	12	12
Develop Edwards-Trinity Plateau Aquifer Supplies	$3,630,000	500	500	500	500	500	500
*Transmission Pipeline Replacement**	*$26,102,000*	*634*	*648*	*665*	*683*	*703*	*722*
TOTAL	**$29,732,000**	**509**	**509**	**509**	**509**	**509**	**509**

**This strategy is for infrastructure required to convey existing and water management strategy supplies and is not included in the total to avoid double counting. The amount shown above is the supply available from other recommended water management strategies.*

5E.21.2 Pecos County Irrigation

Although Pecos County Irrigation has no projected shortages, both irrigation conservation and weather modification are recommended as water management strategies. Weather modification is recommended as a strategy because Pecos County lies within the Trans Pecos Weather Modification Association (TPWMA) precipitation enhancement area.

Potentially Feasible Water Management Strategies Considered for Pecos County Irrigation:

- Irrigation Conservation
- Weather Modification

Pecos County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Weather Modification

The TPWMA attributes an annual increase of 0.33 inches over Pecos County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 12,887 irrigated acres in Pecos County, implementation of this strategy is expected to save 106 acre-feet of water per year at a unit cost of $5.45 per acre-foot.

Table 5E- 52
Recommended Water Strategies for Pecos County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		143,345	143,345	143,345	143,345	143,345	143,345
Supply (Groundwater)		143,345	143,345	143,345	143,345	143,345	143,345
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$16,341,000	7,167	14,335	21,502	21,502	21,502	21,502
Weather Modification	$0	106	106	106	106	106	106
TOTAL	**$16,341,000**	**7,273**	**14,441**	**21,608**	**21,608**	**21,608**	**21,608**

5E.21.3 Pecos County Mining

Mining demands in Pecos County are projected to be as much 7,700 acre-feet per year. Currently developed supplies are limited and mining conservation (recycling) and additional groundwater development is recommended to mee the shortages.

Pecos County Mining Recommended Strategies

- Mining Conservation (Recycling)
- Develop Additional Pecos Valley Aquifer Supplies

Potentially Feasible Water Management Strategies Considered for Reeves County Mining:

- Mining Conservation (Recycling)
- Develop Additional Pecos Valley Aquifer Supplies

Develop Additional Pecos Valley Aquifer Supplies

This strategy assumes that 22 new wells will need to be constructed at a 500-ft depth in order to access the additional aquifer supplies needed in the Pecos Valley Alluvium. Each well is assumed to be operating at a capacity of 100 gpm. This strategy will cost approximately $492,000 and yield an additional 3,000 acre-feet of supply.

Table 5E- 53
Recommended Water Strategy for Pecos County Mining

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		7,700	7,700	7,700	6,200	4,800	3,700
Supply (Groundwater)		4,200	4,200	4,200	4,200	4,200	4,200
Shortage (ac-ft/yr)		3,500	3,500	3,500	2,000	600	500
Recommended Strategies (ac-ft/yr)							
Mining Conservation	$10,780,000	539	539	539	434	67	52
Develop Pecos Valley Aquifer Supplies	$492,000	3,000	3,000	3,000	3,000	3,000	3,000
TOTAL	**$11,272,000**	**3,539**	**3,539**	**3,539**	**3,434**	**3,067**	**3,052**

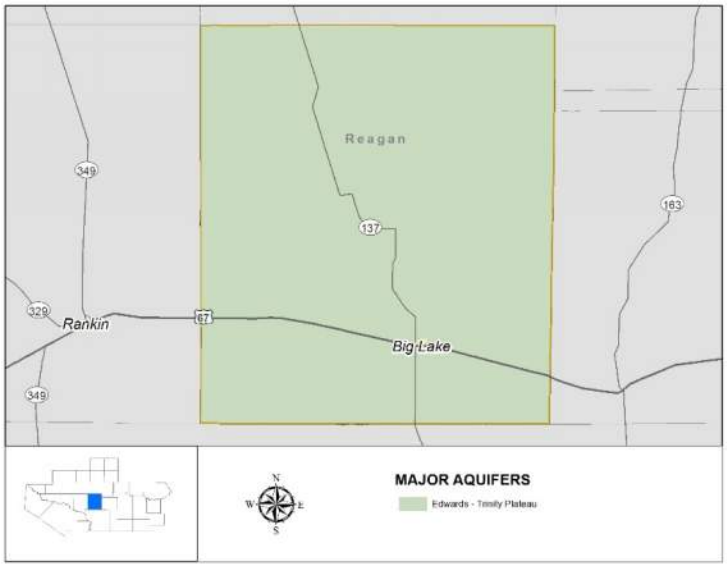
5E.21.4 Pecos County Summary

Pecos County is a groundwater rich county, but a considerable amount of the groundwater has diminished water quality. This can limit its viability for some purposes. Manufacturing and mining users within Pecos County have a projected shortage of around 3,661 acre-feet per year over the planning period. Both of these users are supplied by Fort Stockton, who plans to develop additional groundwater supplies to meet the needs of their customers. Furthermore, Pecos County WCID #1 is interested in diversifying their water supply sources and has a recommended strategy to develop additional groundwater. Conservation is also considered for municipal (Fort Stockton, Iraan, Pecos County WCID #1), irrigation, and mining users. Conservation is discussed further in Chapter 5B.

Table 5E- 54
Pecos County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Strategies
Fort Stockton	Edwards-Trinity-Plateau & Pecos Valley Aquifers in Pecos & Reeves Counties	None	None	Municipal Conservation
Iraan	Edwards-Trinity Plateau, Pecos Valley, & Trinity Aquifer	None	None	Municipal Conservation
Pecos County WCID #1	Pecos Valley/Edwards Trinity (Plateau) Aquifer	None	None	Develop Edwards Trinity (Plateau) Aquifer Supplies, Transmission Pipeline Replacement
Pecos County Fresh Water	Edwards-Trinity Plateau, Pecos Valley, & Trinity Aquifer	None	None	Municipal Conservation
County-Other	Edwards-Trinity Plateau, Pecos Valley, & Trinity Aquifer	None	None	None
Irrigation	Red Bluff Reservoir, Run-of-River, Pecos Valley/Edwards-Trinity (Plateau), Edwards-Trinity Plateau, Pecos Valley, & Trinity, Capitan Reef, Rustler	None	None	Irrigation Conservation Weather Modification
Livestock	Edwards-Trinity Plateau, Pecos Valley, & Trinity, Capitan Reef, Rustler, &Other Aquifers, Local	None	None	None
Manufacturing	Edwards-Trinity-Plateau, Pecos Valley, & Trinity Aquifer	None	None	None
Mining	Edwards-Trinity Plateau, Pecos Valley, & Trinity Aquifer, Sales from Fort Stockton	3,500	0	Mining Conservation/Recycling
Steam Electric	--	--	----	----

5E.22 Reagan County



Nearly all of the water used in Reagan County is obtained from the Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer. Groundwater availability from this aquifer is over 68,000 acre-feet per year. The projected demands in Reagan County are less than 34,000 acre-feet per year in 2020 and are projected to decline to less than 24,000 acre-feet per year by 2070. The supply and demand analysis found that Reagan County has no identified water shortages. However, conservation for the City of Big Lake, irrigation, and mining are still recommended as a way to preserve water for future use. The total amount of expected water savings from conservation is estimated at approximately 1,557 acre-feet per year in 2020 and 3,327 acre-feet per year in 2070.

5E.22.1 Reagan County Irrigation

Although Reagan County Irrigation has no projected unmet needs, both irrigation conservation and weather modification are recommended as water management strategies. Weather modification is a recommended strategy because Reagan County lies within the active precipitation enhancement area of the West Texas Weather Modification Association.

Reagan County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Potentially Feasible Water Management Strategies Considered for Reagan County Irrigation:

- Irrigation Conservation
- Weather Modification

Weather Modification

The West Texas Weather Modification Association attributes an annual increase of 2.77 inches over Reagan County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 8,098 irrigated acres in Reagan County, implementation of this strategy is expected to save 1,869 acre-feet of water per year at a unit cost of $0.19 per acre-foot.

Table 5E- 55
Recommended Water Strategies for Reagan County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		22,031	22,031	22,031	22,031	22,031	22,031
Supply (Groundwater)		22,031	22,031	22,031	22,031	22,031	22,031
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$2,511,534	1,102	2,203	3,305	3,305	3,305	3,305
Weather Modification	$0	1,869	1,869	1,869	1,869	1,869	1,869
TOTAL	**$2,511,534**	**2,971**	**2,203**	**3,305**	**3,305**	**3,305**	**3,305**

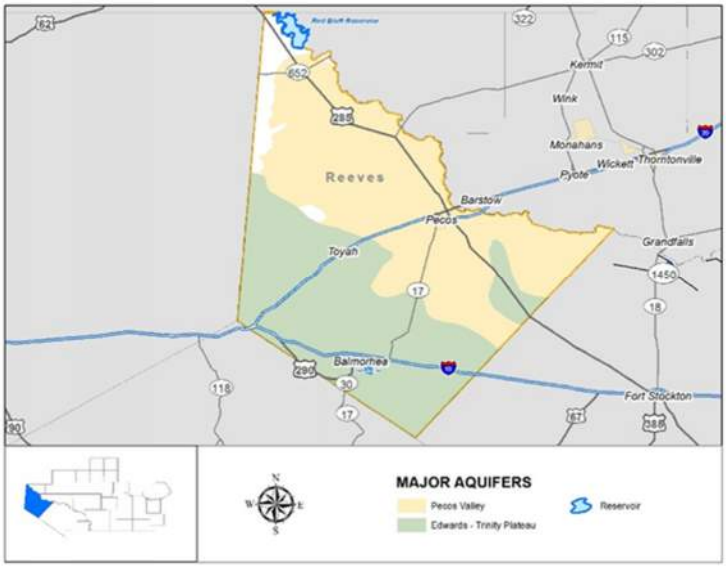
5E.22.2 Reagan County Summary

Reagan County is projected to have no water shortages throughout the planning horizon. However, conservation for municipal (Big Lake), irrigation, and mining users is still recommended as a way to preserve water for future use. In addition, Reagan County lies within the active precipitation enhancement area of the West Texas Weather Modification Association, so weather modification is recommended as a strategy for irrigation users.

Table 5E- 56
Reagan County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Big Lake	Edwards Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	Municipal Conservation
County-Other	Edwards Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Irrigation	Edwards Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	Irrigation Conservation Weather Modification
Livestock	Edwards Trinity-Plateau, Pecos Valley, and Trinity Aquifer, Local Supply	None	None	None
Manufacturing	----	----	----	----
Mining	Edwards Trinity-Plateau, Pecos Valley, and Trinity Aquifer, Well Field Recycling, Direct Reuse sales from Midland and Odessa	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.23 Reeves County



Reeves County relies heavily on groundwater for its water needs. It also uses surface water from Lake Balmorhea and Red Bluff Reservoir for irrigation purposes. Reeves County is another groundwater-rich county in western Region F. There is nearly 200,000 acre-feet per year of groundwater available within the county. However, drought in the Rio Grande Basin, similar to what was experienced in the Colorado Basin, has severely impacted surface water supplies. The hydrology in the Rio Grande WAM has not been extended, and thus current surface water supply estimates for Red Bluff Reservoir may be overestimated.

Reeves County is in the heart of oil and gas development in West Texas. The county includes portions of the Wolfcamp, Bone Spring, and Wolfbone portions of the Delaware Basin, which are highly prolific and this area has been the focus of significant oil and gas exploration. Since this formation can be economically produced even when oil prices are lower, exploration is anticipated to remain steady into the future, unlike previous "boom and bust" cycles. As a result, the communities in the county have also seen a recent surge in population that was not captured at the time population and demand projections were done for this plan. Therefore, additional strategies were identified to help meet these new and growing needs for water supply for Pecos City. Shortages were also identified for the City of Balmorhea and mining throughout the planning horizon. Recommended strategies to meet these needs include developing additional groundwater supplies and purchasing additional water from the City of Fort Stockton (for mining use only). Conservation is also recommended for the municipal, irrigation and mining water users. Livestock and manufacturing users have no recommended strategies. The total amount of expected water savings from conservation is estimated at 3,865 acre-feet per year in 2020 and 9,318 acre-feet per year in 2070.

Water quality, specifically salinity, is a concern throughout the Pecos River Basin. High salinity limits the full use of the Pecos River water resources, including Red Bluff Reservoir. In May 2014, a collaborative effort between the Pecos River Commission, Pecos River Water Quality Coalition, US Army Corps of Engineers (USACE), Texas Water Development Board (TWDB), Texas Commission on Environmental Quality (TCEQ), and the U.S. Geological Survey (USGS) commenced to conduct a comprehensive review of existing studies, identify data gaps, and recommended projects to reduce salinity in the region. This study is called the Pecos River Watershed Assessment and is ongoing at the writing of this plan. Since these projects are not yet defined, they cannot be fully evaluated as part of the Region F Plan. However, the projects identified as a result of this study may result in increased usable water supplies for agricultural, urban, and environmental purposes and are considered to be consistent with this plan.

5E.23.1 Balmorhea

The City of Balmorhea supplies its own municipal users, as well as the City of Toyah (classified under County-Other) and is supplied entirely by groundwater from the Edwards-Trinity Plateau and Pecos Valley Aquifers in Jeff Davis County (Region E). The currently developed supply from this groundwater source is limited, and therefore, the City is projected to have a shortage of 107 acre-feet per year in 2020 and 147 acre-feet per year in 2070. Municipal conservation and development of additional groundwater supply are recommended strategies that can be implemented to meet the needs in Balmorhea.

Potentially Feasible Water Management Strategies Considered for Balmorhea:

- Municipal Conservation
- Develop Additional Edwards-Trinity-Plateau Aquifer Supplies

Balmorhea Recommended Strategies

- Municipal Conservation
- Develop Edwards-Trinity- Plateau Aquifer Supplies

Develop Edwards-Trinity-Plateau Aquifer Supplies

This strategy assumes that one new well will need to be constructed at a 600-ft depth in order to develop the additional groundwater supplies needed in the Edwards-Trinity-Plateau aquifer. This well is assumed to be operating at a capacity of 125 gpm. A transmission pipe 6-inches in diameter and 5 miles long is also needed. This strategy will cost approximately $1.9 million to implement and is estimated to yield an additional 150 acre-feet of water per year.

Table 5E- 57
Recommended Water Strategies for Balmorhea

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		243	254	265	273	278	283
Supply (Groundwater)		136	136	136	136	136	136
Shortage (ac-ft/yr)		107	118	129	137	142	147
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	2	2	2	2	2	2
Develop Edwards-Trinity-Plateau Aquifer Supplies	$1,948,000	150	150	150	150	150	150
TOTAL	**$1,948,000**	**152**	**152**	**152**	**152**	**152**	**152**

5E.23.2 Pecos City

Pecos City is the largest city in Reeves County. In addition to providing water to its own retail customer base, Pecos City also supplies Barstow. Pecos City has three existing well fields: South Worsham, North Worsham, and Ward County Well Field. Water from the North Worsham has elevated levels of TDS and chlorides and must be blended at no more than 5% of the total supply.

Due to increased interest in oil and gas exploration in the surrounding area, Pecos City has recently experienced rapid population growth. This population surge was not captured in the original TWDB projections, but it is anticipated to continue as a permanent workforce moves to the area. As a result, the City is pursuing several additional water management strategies that are examined as part of the Region F plan.

Potentially Feasible Water Management Strategies Considered for Pecos City:

- Municipal Conservation
- Advanced Water Treatment
- Partner with Madera Valley WSC & Expand Well Field
- Direct Non-potable Reuse
- Direct Potable Reuse
- Indirect Potable Reuse with ASR

Pecos City Recommended Strategies

- Municipal Conservation
- Advanced Water Treatment
- Partner with Madera Valley WSC & Expand Well Field
- Direct Non-Potable Reuse
- Direct Potable Reuse

Advanced Groundwater Water Treatment

Poor water quality in the City's existing North Worsham well field severely limits its use. Currently it can only be blended at up to 5% of the total supply. This strategy is to develop an 8 MGD advanced treatment plant which will treat the blended supplies from all three city well fields. This strategy provides additional water supplies by increasing the usable supply from the North Worsham well field. Costs are estimated at $27.6 million.

Partner with Madera Valley WSC & Expand Well Field

The Madera Valley WSC has an existing well field and 10-inch transmission line for their own use. Pecos City is considering partnering with Madera Valley to expand the well field yield an additional 6-8 MGD of average annual supply for both users. The project also includes a 24-inch transmission line for Pecos City to connect to the expanded well field. This strategy is subject to on-going negotiations between Madera Valley WSC and Pecos City and is contingent upon the two entities reaching mutually agreeable terms for the division of water and cost. The total cost for this strategy is estimated at $43.1 million.

Direct Non-Potable Reuse

Pecos City has plans to develop a purple pipe system to supply reuse supplies to irrigation. This would provide peak supplies of 1 MGD or about 560 ac-ft/yr. Costs for this strategy are estimated to be $8.7 million.

Direct Potable Reuse

Pecos City is considering a direct potable reuse project that would be triggered if the population and demand continues to grow rapidly. The size and timing of this strategy may change. For planning purposes, a 2.2 MGD Advanced Treatment Facility was assumed. Concentrate was assumed to be disposed of in a local stream. If a suitable discharge location cannot be found, injection wells may be needed, which will increase the cost estimated for this project. Cost is estimated at $29.5 million.

Table 5E- 58
Recommended Water Strategies for Pecos City

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand (Sales to Barstow)		3,035	3,190	3,343	3,454	3,540	3,605
Supply (Groundwater)		3,035	3,190	3,343	3,454	3,540	3,605
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	29	31	33	34	35	35
Advanced Groundwater Treatment	$27,680,000	3,360	3,360	3,360	3,360	3,360	3,360
Direct Non-Potable Reuse	$8,707,000	560	560	560	560	560	560
Partner w/ Madera Valley WSC & Expand Well Field	$43,107,000		8,960	8,960	8,960	8,960	8,960
Direct Potable Reuse	$29,541,000		925	925	925	925	925
TOTAL	**$109,035,000**	**3,949**	**13,836**	**13,838**	**13,838**	**13,840**	**13,840**

Alternative Water Management Strategies for Pecos City:

- Indirect Potable Reuse with ASR

5E.23.3 Reeves County Mining

Mining demands in Reeves County are projected to be as much as 12,600 acre-feet per year in 2020 and are projected to decline to 6,200 acre-feet per year by 2070. Current, developed groundwater supplies are limited to 1,500 acre-feet from the Pecos Valley Aquifer and 700 acre-feet purchased from the City of Fort Stockton. Consequently, mining users are shown to have a significant shortage throughout the planning horizon, particularly over the next two decades. Recommended strategies to meet these needs include mining conservation (recycling), developing additional groundwater supply, and purchasing additional groundwater from Fort Stockton.

Potentially Feasible Water Management Strategies Considered for Reeves County Mining:

- Mining Conservation (Recycling)
- Develop Additional Pecos Valley Aquifer Supplies

Reeves County Mining Recommended Strategies

- Mining Conservation (Recycling)
- Develop Additional Pecos Valley Aquifer Supplies

Develop Additional Groundwater (Pecos Valley Aquifer)

This strategy assumes that 75 new wells will need to be constructed at a 500-ft depth in order to access the additional aquifer supplies needed in the Pecos Valley Alluvium. Each well is assumed to be operating at a capacity of 100 gpm. This strategy will cost approximately $17.5 million to implement and is estimated to yield an additional 10,400 acre-feet of water per year.

Table 5E- 59
Recommended Water Strategies for Reeves County Mining

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		12,600	12,600	12,100	9,900	7,800	6,200
Supply (Groundwater, Purchased)		2,200	2,200	2,200	2,200	2,200	2,200
Shortage (ac-ft/yr)		10,400	10,400	9,900	7,700	5,600	4,000
Recommended Strategies (ac-ft/yr)							
Mining Conservation/Recycling	$17,640,000	882	882	847	693	546	434
Develop Additional Pecos Valley Aquifer Supplies	$17,465,000	10,400	10,400	10,400	10,400	10,400	10,400
TOTAL	**$35,105,000**	**11,282**	**11,282**	**11,247**	**11,093**	**10,946**	**10,834**

5E.23.4 Reeves County Irrigation

Although Reeves County Irrigation has no projected unmet needs, both irrigation conservation and weather modification are recommended as water management strategies. Weather modification is a recommended strategy because Reeves County lies within the active precipitation enhancement area of the Trans Pecos Weather Modification Association (TPWMA).

Reeves County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Potentially Feasible Water Management Strategies Considered for Reeves County Irrigation:

- Irrigation Conservation
- Weather Modification

Weather Modification

The TPWMA attributes an annual increase of 0.48 inches over Reeves County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 8,138 irrigated acres in Reeves County, implementation of this strategy is expected to save 326 acre-feet of water per year at a unit cost of $1.13 per acre-foot.

Table 5E- 60
Recommended Water Strategies for Reeves County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		58,937	58,937	58,937	58,937	58,937	58,937
Supply (Surface Water, Groundwater)		58,937	58,937	58,937	58,937	58,937	58,937
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$6,719,000	2,947	5,894	8,841	8,841	8,841	8,841
Weather Modification	$0	326	326	326	326	326	326
TOTAL	**$6,719,000**	**3,273**	**6,220**	**9,167**	**9,167**	**9,167**	**9,167**

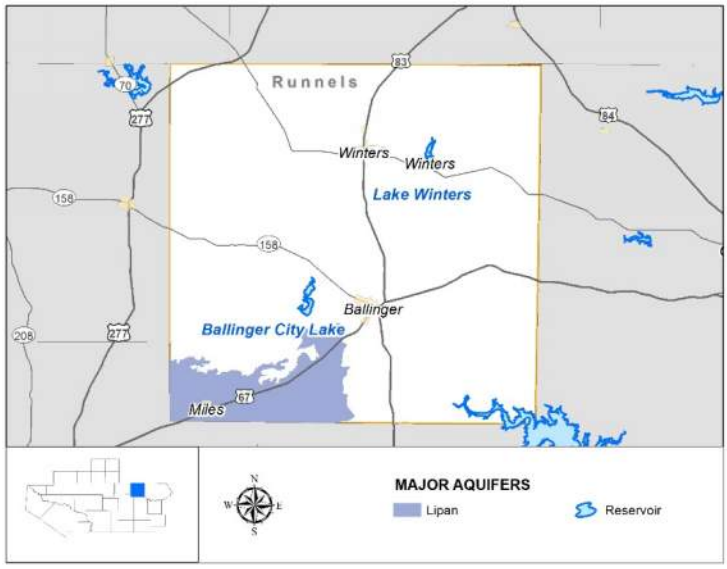
5E.23.5 Reeves County Summary

Water shortages in Reeves County are identified for the City of Balmorhea and mining due to limited supply of developed groundwater. As a result, recommended strategies to meet these needs involve developing additional groundwater supplies or purchasing additional supplies from the City of Fort Stockton (for mining use only). Pecos City has several new strategies including groundwater development, advanced treatment, and reuse to address rapid population growth in their area. Additionally, conservation is recommended for municipal (City of Balmorhea, Madera Valley WSC, Pecos City), irrigation, and mining users. Municipal conservation was not considered for County Other because there was no need. Conservation is discussed in further detail in Chapter 5B.

Table 5E- 61
Reeves County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Balmorhea	Edwards Trinity Plateau and Pecos Valley Aquifer (Jeff Davis County, Region E)	107	147	Municipal Conservation, Develop Edwards-Trinity-Plateau Aquifer Supplies
Madera Valley WSC	Edwards-Trinity Plateau and Pecos Velley Aquifers	None	None	Municipal Conservation
Pecos City	Dockum Aquifer, Edwards-Trinity Plateau and Pecos Valley Aquifers (Ward County)	None	None	Municipal Conservation Advanced Water Treatment Partner with Madera Valley WSC and Expand Well Field Direct Non-Potable Reuse Direct Potable Reuse
County Other	Edwards-Trinity-Plateau and Pecos Valley Aquifers, Sales from Balmorhea	None	None	None
Irrigation	Lake Balmorhea, Red Bluff, Run-of-River, Edwards-Trinity Plateau and Pecos Valley Aquifers, Rustler Aquifer, Igneous Aquifer	None	None	Irrigation Conservation Weather Modification
Livestock	Local Supplies, Rustler Aquifer, Dockum Aquifer, Igneous Aquifer, Edwards-Trinity Plateau and Pecos Valley Aquifers	None	None	None
Manufacturing	Sales from Pecos	None	None	None
Mining	Edwards-Trinity Plateau and Pecos Valley Aquifer (Self Supplied and Sales from Fort Stockton)	10,400	4,000	Mining Conservation (Recycling), Develop Additional Groundwater
Steam Electric	----	----		----

5E.24 Runnels County



Water demands in Runnels County are met through in-county groundwater sources, surface water from local lakes and sales from CRMWD and UCRA. Ballinger and Runnels County-Other show no shortages after subordination of Lake Ballinger, Moonen Lake, and Lake Ivie (accessed through contract with Millersview Doole WSC, Abilene, and CRMWD). In previous rounds, Ballinger has considered additional supplies to expand their water portfolio including connecting to Lake Fort Phantom Hill. At this time, the City is not planning to move forward with this strategy but it may be considered in the future. After subordination and conservation, there is a projected shortage of about 190 acre-feet per year in 2020. The largest shortage in Runnels County is associated with the City of Winters. The City of Miles and North Runnels WSC also are identified with shortages during the planning horizon. The options to meet the projected shortages in Runnels County are limited. Nearly all of the available groundwater within the county is allocated to current users. Local surface water lakes are small and susceptible to drought.

5E.24.1 Miles

Miles Recommended Strategies

- Municipal Conservation
- Subordination (UCRA)
- Supplies from UCRA (San Angelo Strategies)

The City of Miles has a contract with UCRA for water from O.C. Fisher. The water is treated by San Angelo and delivered through UCRA's northeast water supply line. The contract with UCRA expires in 2031, but it is expected to be renewed. UCRA is planning to fully meet Miles' water demands; thus, when considering supplies from San Angelo's strategies that supply water to UCRA, there are no identified shortages for Miles. The recommended strategies for Miles are conservation, subordination of UCRA's water supplies, and additional supplies from UCRA/San Angelo strategies.

Table 5E- 62
Recommended Water Strategies for Miles

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		113	126	122	121	120	120
Supply (Groundwater, Purchased from UCRA)		94	92	87	81	78	73
Shortage (ac-ft/yr)		19	34	35	40	42	47
Recommended Strategies (ac-ft/yr)							
Municipal Conservation		3	3	3	3	3	3
Subordination (UCRA)	$0	10	8	7	8	6	5
Supplies from UCRA (San Angelo Strategies)	$0	9	26	28	32	36	42
TOTAL	**$0**	**22**	**37**	**38**	**43**	**45**	**50**

5E.24.2 North Runnels WSC

North Runnels WSC Recommended Strategies

- Municipal Conservation
- Subordination (Winters, Ballinger)
- Supplies from Winters Strategies

North Runnels Water Supply Corporation (WSC) purchases water from the City of Winters and has an emergency connection with the City of Ballinger. Before subordination, North Runnels WSC is projected to have a shortage of just below 200 acre-feet per year throughout the planning horizon. When considering conservation and subordination, this shortage decreases to around 100 acre-feet per year. The recommended strategies for North Runnels WSC include municipal conservation, subordination of Winters and Ballinger's supplies, and receiving water from the City of Winters strategies. There is no new infrastructure needed for North Runnels WSC to continue receiving supplies from Winters.

Table 5E- 63
Recommended Water Strategies for North Runnels WSC

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		203	201	196	195	195	196
Supply (Purchased from Winters, Ballinger)		9	10	10	10	10	9
Shortage (ac-ft/yr)		194	191	186	185	185	187
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	5	5	5	5	5	5
Subordination (Purchased from City of Winters, Ballinger)	$0	86	86	87	87	87	89
Winters Strategies Supply	$0	103	105	99	98	98	98
TOTAL	**$0**	**194**	**196**	**191**	**190**	**190**	**192**

5E.24.3 Winters

The City of Winters' source of water is Lake Winters. This lake was significantly impacted from the recent drought and the reliable supply is estimated at less than 200 acre-feet per year with subordination. Winters provides water to its residents and rural customers in Runnels County, as well as a small amount of water to manufacturing. Considering the City's current customers, Winters is shown to have a projected shortage of 220 acre-feet per year in 2020. To meet this need, Winters could purchase water from another provider, such as Ballinger, Abilene, or CRMWD. The pipeline from Lake Ivie to Abilene runs near Lake Winters, which could provide water from Lake Ivie. Another option would be to construct a new 15-mile pipeline from Ballinger to Winters. This option would be expensive for such a small quantity of water. For purposes of this plan, the recommended strategies for Winters is to purchase water from Abilene.

Potentially Feasible Water Management Strategies Considered for Winters:

- Municipal Conservation
- Purchase from Provider

Winters Recommended Strategies

- Municipal Conservation
- Purchase from Provider

Purchase Water from a Provider

There are multiple water providers that utilize the Abilene pipeline from Lake Ivie. It is assumed that the City would purchase up to 220 acre-feet per year of Lake Ivie water from one of the providers. It would require a valve and short pipeline, where the water would then be discharged to a tributary of Lake Winters. The capital cost of the strategy is $974,000.

Table 5E- 64
Recommended Water Strategies for Winters

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand (includes sales to N. Runnels WSC)		395	385	369	367	366	367
Supply (Winters Lake)		0	0	0	0	0	0
Shortage (ac-ft/yr)		395	385	369	367	366	367
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	8	9	9	9	9	9
Subordination (Winters Lake)	$0	175	175	175	175	175	175
Purchase from Provider	$974,000	212	212	212	212	212	212
TOTAL	**$974,000**	**395**	**396**	**396**	**396**	**396**	**396**

5E.24.4 Runnels County Summary

Runnels County is able to meet its projected water demands through a suite of strategies that include conservation, subordination for surface water lakes, and purchasing water from other providers.

Table 5E- 65
Runnels County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Ballinger	Sales from Millersview-Doole (CRMWD Supplies), Sales from Abilene (CRMWD Supplies) Ballinger/Moonen Lake	417	395	Municipal Conservation, Subordination
Coleman County SUD	See Coleman County			
Miles	Sales from UCRA, Lipan Aquifer	19	47	Municipal Conservation, Subordination, Supplies from UCRA (San Angelo) strategies
Millersview-Doole WSC	See McCulloch County			
North Runnels WSC	Sales from Winters, Sales from Ballinger	Included in Winters shortage	Included in Winters shortage	Municipal conservation, Subordination, Winters Strategies Supply
Winters	Winters Lake	395	367	Municipal Conservation, Subordination, Purchase from Provider
County Other	Sales from Ballinger, Other Aquifer	Included in Ballinger shortage	Included in Ballinger shortage	Municipal Conservation, Subordination
Irrigation	Reuse sales from Winters, Other Aquifer, Run-of-River	None	None	Irrigation Conservation
Livestock	Livestock Local Supplies, Other Aquifer, Lipan Aquifer	None	None	None
Manufacturing	Sales from Ballinger, Lipan Aquifer	None	None	None
Mining	Other Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.25 Schleicher County

Schleicher County obtains all of its water from the Edwards-Trinity Plateau aquifer. Total demands for the county are less than 4,000 acre-feet per year. There are sufficient groundwater supplies in Schleicher County and the county is shown to have no shortages over the planning period. Conservation is still recommended for the City of Eldorado, Irrigation, and Mining.

5E.25.1 Schleicher County Irrigation

Although Schleicher County Irrigation has no projected unmet needs, both irrigation conservation and weather modification are recommended as water management strategies. Weather modification is a recommended strategy because Schleicher County is located within the active precipitation enhancement area of the West Texas Weather Modification Association.

Schleicher County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Potentially Feasible Water Management Strategies Considered for Schleicher County Irrigation:

- Irrigation Conservation
- Weather Modification

Weather Modification

The West Texas Weather Modification Association attributes an annual increase of 2.34 inches over Schleicher County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 1,412 irrigated acres in Schleicher County, implementation of this strategy is expected to save 275 acre-feet of water per year at a unit cost of $0.23 per acre-foot.

Table 5E- 66
Recommended Water Strategies for Schleicher County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demands		1,811	1,811	1,811	1,811	1,811	1,811
Supply (Groundwater)		1,811	1,811	1,811	1,811	1,811	1,811
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$68,818	91	109	109	109	109	109
Weather Modification	$0	275	275	275	275	275	275
TOTAL	**$68,818**	**366**	**384**	**384**	**384**	**384**	**384**

5E.25.2 Schleicher County Summary

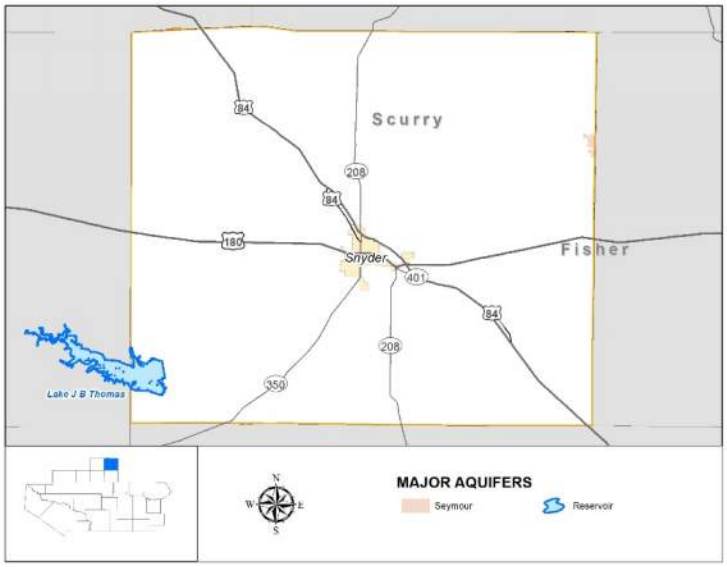
There are no shortages over the planning horizon in Schleicher County. Municipal, irrigation, and mining conservation are all recommended to preserve water supplies for future user. Weather modification is also recommended for irrigators as part of the active West Texas Weather Modification Association program.

Table 5E- 67
Schleicher County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Eldorado	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	Municipal Conservation
County Other	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Irrigation	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	Irrigation Conservation Weather Modification
Livestock	Livestock Local Supplies, Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Manufacturing	----	----	----	----
Mining	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.26 Scurry County

Scurry County has limited surface water and groundwater supplies. Water from CRMWD sources is provided to the City of Snyder and its customers. Groundwater is obtained from the Dockum aquifer and is the primary source of supply for the other water users within the county. There is a small amount of alluvium groundwater (Other aquifer). The current demands on the Dockum aquifer exceed the availability (MAG values). As a result, there are identified shortages that may not be able to be met by supplies within Scurry County.



5E.26.1 Snyder

The City of Snyder is a member city of CRMWD and obtains all of its water from this wholesale provider. With conservation and subordination, CRMWD can fully meet Snyder's need. In the past, CRMWD and Snyder considered implementing a direct reuse project, similar to the project developed for Big Spring. At this time, there are no plans to move forward with this strategy and therefore it was not evaluated. Recommended strategies for Snyder are municipal conservation and subordination.

Potentially Feasible Water Management Strategies Considered for Snyder:

- Municipal Conservation
- Subordination

Snyder Recommended Strategies

- Municipal Conservation
- Subordination

Table 5E- 68
Recommended Water Strategies for Snyder

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		2,458	2,671	2,785	2,963	3,149	3,345
Future Demands (Scurry County-Other)		373	414	447	491	547	607
Supply (Purchase from CRMWD, Groundwater)		2,217	2,671	2,785	2,659	2,534	2,400
Shortage (ac-ft/yr)		614	414	447	795	1,162	1,552
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	41	47	51	55	59	93
Subordination (CRMWD Supplies)	$0	614	414	447	795	1,162	1,552
TOTAL	**$0**	**655**	**461**	**498**	**850**	**1,221**	**1,645**

5E.26.2 Scurry County Other

Scurry County Other includes rural water users living outside of a named water user group. Most of these users obtain their water from groundwater and will continue to use groundwater. However, due to the MAG limits, there is no available water from the Dockum aquifer. Other County-Other users obtain water from the City of Snyder, who purchases water from CRMWD. For purposes of this plan, this water user group is expected to meet most of their needs with water supplied by the City of Snyder, which will come from strategies developed by CRMWD. The costs for this strategy are assumed to be only the purchase cost of the water. The capital costs are zero since it is assumed no additional infrastructure would be needed to facilitate this supply. Subordination of the water supplies received by Snyder, as well as municipal conservation are also recommended strategies for Scurry County Other.

Scurry County Other Recommended Strategies

- Municipal Conservation
- Subordination (Snyder)
- Purchase water from Snyder (CRMWD supplies)

Potentially Feasible Water Management Strategies Considered for Scurry County Other:

- Purchase water from Snyder
- Municipal Conservation
- Subordination

Table 5E- 69
Recommended Water Strategies for Scurry County-Other

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		808	846	886	943	1,012	1,085
Supply (Groundwater, Purchase from Snyder)		406	432	439	421	406	393
Shortage (ac-ft/yr)		402	414	447	522	606	692
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	20	22	24	26	28	30
Subordination (CRMWD Supplies through Snyder)	$0	29	0	0	31	59	85
Purchase from Snyder	$0	373	414	447	491	547	607
TOTAL	**$0**	**422**	**436**	**471**	**548**	**634**	**722**

5E.26.3 Scurry County Manufacturing

Manufacturing in Scurry County is projected to have shortages of roughly 130 acre-feet in 2020 and 156 acre-feet in 2070. Drilling supplemental groundwater wells in the local alluvium will provide additional water to their existing supply. Water from this source has been identified as being suitable for industrial use and is a recommended strategy.

Potentially Feasible Water Management Strategies Considered for Scurry County Manufacturing:

- Develop Other Aquifer Supplies

Scurry County Manufacturing Recommended Strategies

- Develop Other Aquifer Supplies

Develop Other Aquifer Supplies

This strategy assumes five new wells would be constructed to produce 160 acre-feet per year from the Other aquifer alluvium associated with the Dockum aquifer. The capital cost for this strategy is $677,000.

Table 5E- 70
Recommended Water Strategies for Scurry County Manufacturing

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		156	186	186	186	186	186
Supply (Groundwater)		26	30	30	30	30	30
Shortage (ac-ft/yr)		130	156	156	156	156	156
Recommended Strategies (ac-ft/yr)							
Develop Other Aquifer Supplies	$677,000	160	160	160	160	160	160

5E.26.4 Scurry County Mining

Scurry County is projected to have an increase in mining demands from 2020 to 2040, then a decrease until 2070. Currently, water from the Dockum aquifer is used for mining purposes, but due to limitations of the MAGs, this supply is not available under regional planning rules and mining is shown to have an unmet need. However, it is anticipated that the mining industry, as an exempt user, will continue to use groundwater from the Dockum aquifer as needed to meet their demands. Mining conservation/recycling is also recommended.

5E.26.5 Scurry County Summary

Before applying potential savings from conservation and subordination, the total need for Scurry County is projected to be nearly 7,500 acre-feet in 2020. The majority of Scurry County's shortages are for irrigation. The City of Snyder also has a shortage, however, their needs are fully met by CRMWD and municipal conservation. The shortages for County Other are shown to be met through sales from Snyder. However, much of the County Other demand will likely continue to be met through local groundwater supplies that cannot be shown due to MAG limitations. Some manufacturing shortages can be met through additional groundwater development. Some of the mining demands can likely be met through conservation/recycling of water, but there is still an unmet need. It is anticipated that the mining industry will continue to develop groundwater as needed beyond the MAG. The only strategy identified for irrigation is conservation of water. Due to the limitations of the groundwater supplies in Scurry County, the county is shown to have unmet needs for irrigation and mining.

Table 5E- 71
Scurry County Summary

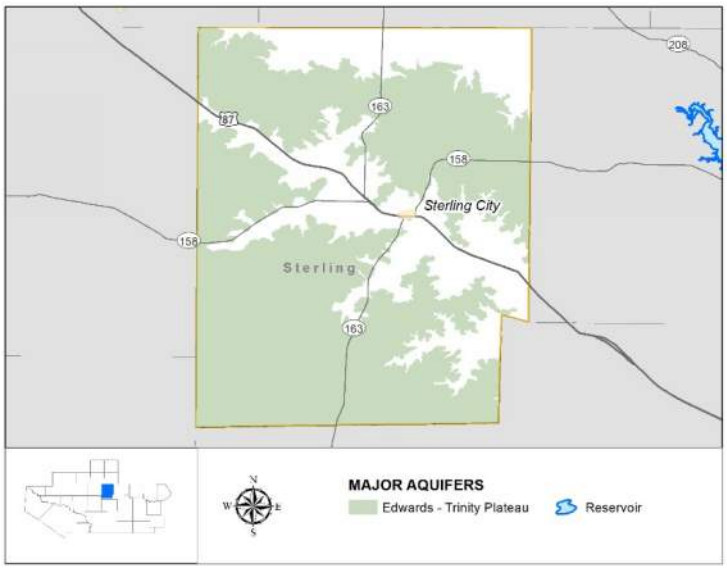
Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Strategies
Snyder	CRMWD Sources	241	945	Municipal Conservation, Subordination
County Other	CRMWD Sources, Dockum, Local Alluvium Aquifers	373	607	Municipal Conservation, Sales from Snyder
Irrigation	Run-of-River, Dockum Aquifer	6,531	6,563	Irrigation Conservation
Livestock	Dockum Aquifer, Other Aquifer, Local Supply	None	None	None
Manufacturing	Dockum Aquifer	130	156	Additional Groundwater Development (Other Aquifer)
Mining	Dockum Aquifer	242	144	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

Table 5E- 72
Unmet Needs in Scurry County
-Values in Acre-Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Irrigation	6,153	5,799	5,582	5,579	5,577	5,580
Mining	222	363	385	290	196	132
TOTAL	**6,375**	**6,162**	**5,967**	**5,869**	**5,773**	**5,712**

5E.27 Sterling County

Most of the water supplies for Sterling County are obtained from the Edwards-Trinity Plateau aquifer. There is about 850 acre-feet per year of supply from the Lipan aquifer, which is used by Sterling City and agricultural users. Total demands in Sterling County are about 2,200 acre-feet per year in 2020 and decrease to about 1,600 acre-feet per year in 2070. There are sufficient supplies to meet these demands, so Sterling County has no shortages. Therefore, the only recommended strategies for water user groups in Sterling County are conservation (municipal, irrigation, and mining) and weather modification.



5E.27.1 Sterling County Irrigation

Although Sterling County Irrigation has no projected unmet needs, both irrigation conservation and weather modification are recommended as water management strategies. Weather modification is a recommended strategy because Sterling County is located within the active precipitation enhancement area of the West Texas Weather Modification Association.

Sterling County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Potentially Feasible Water Management Strategies Considered for Sterling County Irrigation:

- Irrigation Conservation
- Weather Modification

Weather Modification

The West Texas Weather Modification Association attributes an annual increase of 1.39 inches over Sterling County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 411 irrigated acres in Sterling County, implementation of this strategy is expected to save 48 acre-feet of water per year at a unit cost of $0.39 per acre-foot.

Table 5E- 73
Recommended Water Strategies for Sterling County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$102,000	45	109	109	109	109	109
Weather Modification	$0	48	48	48	48	48	48
TOTAL	**$102,000**	**93**	**157**	**157**	**157**	**157**	**157**

5E.27.2 Sterling County Summary

Table 5E- 74
Sterling County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Sterling City	Lipan Aquifer	None	None	Municipal Conservation
County Other	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifers	None	None	None
Irrigation	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifers, Run-of-River	None	None	Irrigation Conservation Weather Modification
Livestock	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifers, Livestock Local Supplies	None	None	None
Manufacturing	----	----	----	----
Mining	Edwards-Trinity Plateau, Pecos Valley, and Trinity Aquifers	None	None	Mining Conservation/Recycling
Steam Electric	----	----	----	----

5E.28 Sutton County

The Edwards-Trinity Plateau aquifer is the primary source of water for Sutton County. Small amounts of local surface water supplies for livestock and irrigation are also used. The water demands in the county total about 3,200 acre-feet per year in 2020 and are expected to slightly decrease to about 3,140 acre-feet per year by 2070. Sutton County has sufficient water resources to meet these demands and has no identified shortages. The City of Sonora is considering developing additional groundwater.

5E.28.1 Sonora

The City of Sonora has no water shortages over the planning horizon. Municipal conservation is still recommended as a way to preserve water for future or other uses. The City is also planning to develop additional groundwater wells for additional supply and water security.

Potentially Feasible Water Management Strategies Considered for Sonora:

- Municipal Conservation
- Develop Additional Groundwater

Sonora Recommended Strategies

- Municipal Conservation
- Develop Additional Edwards-Trinity-Plateau Aquifer Supplies

Develop Additional Edwards-Trinity-Plateau Aquifer Supplies

The City has an existing well field in the Edwards-Trinity-Plateau Aquifer near Interstate 10. This strategy is to develop two additional 30 gpm, 420-ft depth wells in the same well field and associated collection piping. Additional transmission infrastructure was not included since it is an expansion of an existing facility.

Table 5E- 75
Recommended Water Strategies for Sonora

	Capital Cost	2020	2030	2040	2050	2060	2070
Demands		1,048	1,108	1,126	1,142	1,153	1,159
Supply (Groundwater)		1,048	1,108	1,126	1,142	1,153	1,159
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	18	20	20	20	21	21
Develop Additional Edwards-Trinity-Plateau Aquifer Supplies	$437,000	35	35	35	35	35	35
TOTAL	**$437,000**	**53**	**55**	**55**	**55**	**56**	**56**

5E.28.2 Sutton County Irrigation

Although Sutton County Irrigation has no projected unmet needs, both irrigation conservation and weather modification are recommended as water management strategies. Weather modification is a recommended strategy because Sutton County is located within the active precipitation enhancement area of the West Texas Weather Modification Association.

Sutton County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Potentially Feasible Water Management Strategies Considered for Sutton County Irrigation:

- Irrigation Conservation
- Weather Modification

Weather Modification

The West Texas Weather Modification Association attributes an annual increase of 1.21 inches over Sutton County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 341 irrigated acres in Sutton County, implementation of this strategy is expected to save 34 acre-feet of water per year at a unit cost of $0.45 per acre-foot.

Table 5E- 76
Recommended Water Strategies for Sutton County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demands		1,120	1,120	1,120	1,120	1,120	1,120
Supply (Groundwater)		1,120	1,120	1,120	1,120	1,120	1,120
Shortage (ac-ft/yr)		0	0	0	0	0	0
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$128,000	56	112	168	168	168	168
Weather Modification	$0	34	34	34	34	34	34
TOTAL	**$128,000**	**90**	**146**	**202**	**202**	**202**	**202**

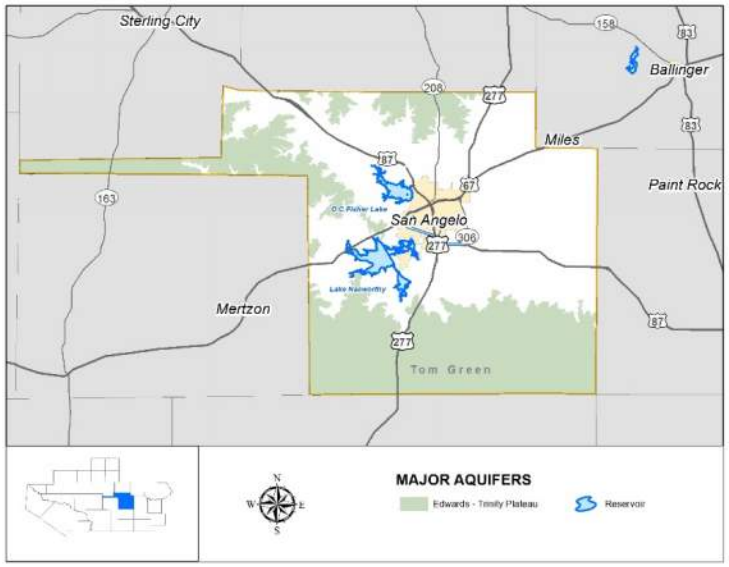
5E.28.3 Sutton County Summary

Sutton County has no identified shortages. It is recommended that water users in Sutton County implement conservation measures to preserve the water resources in the county, including municipal, irrigation and mining water users. In addition, the City of Sonora is planning to develop additional groundwater supplies for use by the City.

Table 5E- 77
Sutton County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Sonora	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	Municipal Conservation Develop Edwards-Trinity-Plateau Aquifer Supplies
County Other	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	None
Irrigation	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer, Run-of-River	None	None	Irrigation Conservation Weather Modification
Livestock	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer, Livestock Local Supplies	None	None	None
Manufacturing	Sales from Sonora	----	----	----
Mining	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifer	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.29 Tom Green County



Tom Green County is home to the City of San Angelo and a large irrigation district, the Tom Green Water Control and Improvement District 1. Over 60 percent of the water demand in the county is for irrigation water use. Most of the remaining demand is associated with San Angelo, which is classified as a major water provider in Region F. Water supplies in Tom Green County include the Concho River, surface water reservoirs, and local aquifers. The Lipan aquifer, a minor aquifer, provides the greatest amount of groundwater within the county. Due to the drought, the reliable supplies from surface water has been significantly impacted. The remainder of the shortage in the county is associated with San Angelo and its customers. No other water user groups in Tom Green County have identified water shortages. The water management strategies for San Angelo and its customers, including Goodfellow Air Force Base, manufacturing, and UCRA, are discussed in Chapter 5D (Major Water Provider Water Management Strategies).

5E.29.1 Upper Colorado River Authority (UCRA)

The Upper Colorado River Authority (UCRA) is a wholesale water provider in Tom Green County. UCRA owns the water rights in O.C. Fisher Reservoir and Mountain Creek Reservoir. The Authority has an agreement with the City of San Angelo for San Angelo to treat up to 1,000 acre-feet per year of water from any of San Angelo's sources in return for water from O.C. Fisher. The City of Miles and local rural water supply corporations in Tom Green and Concho Counties contract with UCRA to provide treated water which is transmitted through either San Angelo's or the retail customer's systems.

Table 5E- 78
Supply and Demand Summary for UCRA

Supplies	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
San Angelo System Supplies	367	330	313	293	276	257
Total Availability	**367**	**330**	**313**	**293**	**276**	**257**
Current Demands	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Miles	113	126	122	121	120	120
Concho Rural WC	100	100	100	100	100	100
Tom Green County-Other (Red Creek MUD)	100	100	100	100	100	100
Tom Green County-Other (Petrafirma)	145	145	145	145	145	145
Tom Green County-Other (Twin Buttes Water System)	20	20	20	20	20	20
Mining, Tom Green County (Globe Energy)	10	10	10	10	10	10
Total Current Demands	**488**	**501**	**497**	**496**	**495**	**495**
Potential Future Demands	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Concho Rural WC (Potential Future)	50	50	50	50	50	50
Total Future Demands	**50**	**50**	**50**	**50**	**50**	**50**
Shortage	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Current Customers	121	171	184	203	219	238
Future Customers	50	50	50	50	50	50

Due to shortages in the supply from the San Angelo, UCRA shows a shortage for current users; however, the water management strategies developed by San Angelo will ultimately enable them to meet the full contractual amount. Brush control is also a recommended strategy for UCRA, who is willing to partner with entities looking to implement a program should funding become available. Additional information on the Brush Control strategy can be found in Chapter 5C.

Potentially Feasible Water Management Strategies Considered for UCRA:

- Brush Control
- Supply from San Angelo Strategies

UCRA Recommended Strategies

- Brush Control
- Supply from San Angelo Strategies

Table 5E- 79
Recommended Water Strategies for UCRA

	2020	2030	2040	2050	2060	2070
Supply	367	330	313	293	276	257
Current Demand	488	501	497	496	495	495
Future Demands	50	50	50	50	50	50
Surplus (Shortage)	(171)	(221)	(234)	(253)	(269)	(288)
Recommended Strategies (acre-feet per year)						
San Angelo Water Management Strategies	633	670	687	707	724	743
Brush Control	Included with San Angelo Strategies. See Chapters 5C and 5D.					
Total	**633**	**670**	**687**	**707**	**724**	**743**

5E.29.2 Tom Green County Irrigation

Irrigation in Tom Green County has no projected unmet needs, however, both irrigation conservation and weather modification are recommended as water management strategies. Irrigation conservation of water can reduce demands and more efficiently use existing supplies. Tom Green County is also located within the active precipitation enhancement area of the West Texas Weather Modification Association. The recommended strategies for irrigation in Tom Green County are conservation and weather modification.

Potentially Feasible Water Management Strategies Considered for Tom Green County Irrigation:

- Irrigation Conservation
- Weather Modification

Tom Green County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Weather Modification

The West Texas Weather Modification Association attributes an annual increase of 2.73 inches over Tom Green County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 19,604 irrigated acres in Tom Green County, implementation of this strategy is expected to save 2,007 acre-feet of water per year at a unit cost of $0.44 per acre-foot.

Table 5E- 80
Recommended Strategies for Tom Green County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		42,493	42,493	42,493	42,493	42,493	42,493
Supply (Groundwater, ROR)		43,051	43,002	42,945	42,930	42,879	42,825
Surplus (ac-ft/yr)		558	509	452	437	386	332
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$3,875,000	2,125	4,249	5,099	5,099	5,099	5,099
Weather Modification	$0	2,007	2,007	2,007	2,007	2,007	2,007
TOTAL	**$3,875,000**	**4,132**	**6,256**	**7,106**	**7,106**	**7,106**	**7,106**

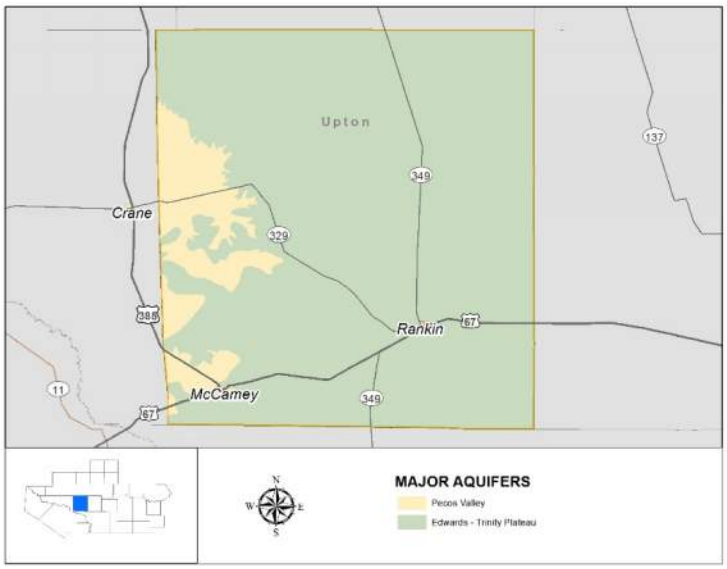
5E.29.3 Tom Green County Summary

Tom Green County is the second largest demand county in Region F. As previously discussed supplies are limited and the county shows a total shortage of over 7,000 acre-feet per year in 2020 and 12,000 acre-feet per year by 2070. Some of this shortage can be reduced through both conservation and subordination. The rest of these shortages can be met through the implementation of infrastructure strategies and transfers between water user groups.

Table 5E- 81
Tom Green County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Concho Rural WC	Lipan Aquifer, Edwards-Trinity Aquifers, Sales from UCRA	None	None	Municipal Conservation UCRA Supplies (San Angelo Strategies)
DADS Supported Living	Lipan Aquifer	None	None	Municipal Conservation
Goodfellow Air Force Base	Sales from San Angelo			Municipal Conservation, Supply from San Angelo Strategies
Millersview-Doole WSC	See McCulloch County			
San Angelo	See Chapter 5D for Major Water Providers			
Tom Green County FSD 3	Lipan Aquifer	None	None	Municipal Conservation
County Other	Lipan Aquifer, Edwards-Trinity Aquifer, Other Aquifers, Sales from UCRA	None	None	Supply from UCRA (San Angelo Strategies)
Irrigation	Lipan Aquifer, Edwards-Trinity Aquifer, and Other Aquifers, Reuse, Twin Buttes/Nasworthy, Run-of-River	None	None	Irrigation Conservation Weather Modification
Livestock	Lipan Aquifer, Edwards-Trinity Aquifer, Other Aquifers, Livestock Local Supplies	None	None	None
Manufacturing	Lipan Aquifer, Sales from San Angelo	51	193	Supply from San Angelo Strategies
Mining	Lipan Aquifer, Sales from UCRA	None	None	Mining Recycling
Steam Electric	----	----	----	----

5E.30 Upton County



Water demands in Upton County are primarily met with groundwater from the Edwards-Trinity Plateau aquifer. Some non-municipal water use groups obtain water from the Dockum aquifer; however, this water is sparsely used due to water quality concerns. In addition to groundwater, mining users in Upton County purchase wastewater from Midland and Odessa to meet their demands. The total water demands for the county are about 19,000 acre-feet per year in 2020 and 13,700 acre-feet per year in 2070. Upton County has sufficient supplies to meet these needs and no water shortages were identified. It is recommended that conservation for McCamey, Rankin, irrigation and mining be implemented as a way to preserve water for future use. County Other, livestock, and manufacturing have no recommended strategies.

5E.30.1 Upton County Summary

Table 5E- 82
Upton County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
McCamey	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers	None	None	Municipal Conservation
Rankin	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers	None	None	Municipal Conservation
County-Other	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers	None	None	None
Irrigation	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers, Dockum Aquifer	None	None	Irrigation Conservation
Livestock	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers	None	None	None
Manufacturing	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers, Dockum Aquifer	None	None	None
Mining	Edwards-Trinity-Plateau, Pecos Valley, and Trinity Aquifers, Sales from Midland (Reuse Water), Sales from Odessa (Reuse Water)	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.31 Ward County

Ward County is located in the western part of Region F. The county's primary source of water is the Pecos Valley aquifer. There are also smaller quantities of water associated with the Capitan Reef and Dockum aquifers. Based on developed supplies, all water users in Ward County can meet the projected demands, with the exception of steam electric power, which is shown to have artificially high demands. It is expected that any current demands can be met with groundwater supplies in Ward County, if needed.

5E.31.1 Grandfalls

Grandfalls Recommended Strategies

- Develop Pecos Valley Aquifer Supplies

Grandfalls existing water supplies are from CRMWD's Ward County Well Field. Grandfalls' contract with CRMWD for water supplies will expires in 2049. Starting in 2050, it is assumed they will need to develop their own well field in the Pecos Valley Aquifer in Ward County. Alternatively, Grandfalls could negotiate a new contract or contract extension with CRMWD if mutually agreeable terms can be reached at that time.

Potentially Feasible Water Management Strategies Considered for Grandfalls:

- Develop Pecos Valley Aquifer Supplies

Table 5E- 83
Recommended Water Strategies for Grandfalls

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		135	141	145	149	152	155
Supply (Groundwater)		135	141	145	0	0	0
Shortage (ac-ft/yr)		0	0	0	149	152	155
Recommended Strategies (ac-ft/yr)							
Municipal Conservation	$0	1	1	1	1	2	2
Develop Pecos Valley Aquifer Supplies	$2,410,000	0	0	0	155	155	155
TOTAL	**$2,410,000**	**1**	**1**	**1**	**156**	**157**	**157**

5E.31.2 Ward County Irrigation

Although Ward County Irrigation has no projected unmet needs, both irrigation conservation and weather modification are recommended as water management strategies. Weather modification is a recommended strategy because Ward County is located within the active precipitation area of the Trans Pecos Weather Modification Association (TPWMA).

Potentially Feasible Water Management Strategies Considered for Ward County Irrigation:

- Irrigation Conservation
- Weather Modification

Ward County Irrigation Recommended Strategies

- Irrigation Conservation
- Weather Modification

Weather Modification

The TPWMA attributes an annual increase of 0.95 inches over Ward County due to their weather modification efforts in 2016. This strategy assumes that the water savings from precipitation enhancement will be attributed to county irrigation and that irrigation usage occurs predominately during the growing season. Since there are approximately 3,275 irrigated acres in Ward County, implementation of this strategy is expected to save 259 acre-feet of water per year at a unit cost of $0.57 per acre-foot.

Table 5E- 84
Recommended Water Strategies for Ward County Irrigation

	Capital Cost	2020	2030	2040	2050	2060	2070
Demand		3,160	3,160	3,160	3,160	3,160	3,160
Supply (Groundwater)		6,058	6,053	6,054	6,061	6,070	6,076
Shortage (ac-ft/yr)		2,898	2,893	2,894	2,901	2,910	2,916
Recommended Strategies (ac-ft/yr)							
Irrigation Conservation	$360,000	158	316	474	474	474	474
Weather Modification	$0	259	259	259	259	259	259
TOTAL	**$360,000**	**417**	**575**	**733**	**733**	**733**	**733**

5E.31.3 Ward County Steam Electric Power

The current steam electric power demand in Ward County is associated with the Luminant Permian Basin Power Plant. This facility uses groundwater from the Pecos Valley aquifer. The demands shown in the Plan are based on 2010 use, when the power plant utilized steam technology. Over the past decade, both steam units have been retired and this plant has switched to combustion-based generation, reducing water needs significantly. Since then, the highest annual water usage from this plant was 123 acre-feet in 2012, and water needs are not expected to grow over the planning horizon. Thus, the shortages shown for steam electric power are artificial and no current water management strategies were developed for this user. This is shown as an unmet need in the Plan.

5E.31.4 Ward County Summary

Ward County has sufficient supplies to meet its needs. The only shortage identified for Ward County is for steam electric power; however, this shortage is artificial and all needs can be met with current groundwater supplies. Conservation is also recommended for municipal (Barstow, Grandfalls, Monahans, Southwest Sandhills WSC, Wickett, County-Other), irrigation and mining users. There are no shortages and no strategies for livestock and manufacturing.

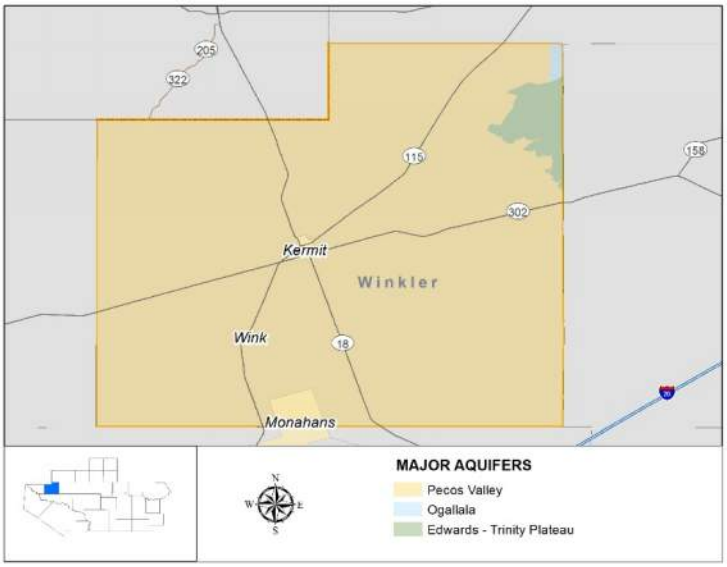
Table 5E- 85
Ward County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Barstow	Dockum Aquifer	None	None	Municipal Conservation
Grandfalls	Sales from CRMWD	None	155	Municipal Conservation Develop Pecos Valley Aquifer Supplies
Monahans	Edwards-Trinity-Plateau and Pecos Valley Aquifer	None	None	Municipal Conservation
Southwest Sandhills WSC	Sales from Monahans	None	None	Municipal Conservation
Wickett	Edwards-Trinity-Plateau and Pecos Valley Aquifer	None	None	Municipal Conservation
County Other	Sales from CRMWD, Edwards-Trinity-Plateau and Pecos Valley Aquifer, Dockum Aquifer	None	None	Municipal Conservation
Irrigation	Reuse sales from Monahans, Edwards-Trinity-Plateau and Pecos Valley Aquifer, Dockum Aquifer, Red Bluff Reservoir, Rio Grande Run-of-River	None	None	Irrigation Conservation Weather Modification
Livestock	Livestock Local Supplies, Edwards-Trinity-Plateau and Pecos Valley Aquifer, Dockum Aquifer	None	None	None
Manufacturing	Pecos Valley Aquifer	None	None	None
Mining	Pecos Valley Aquifer, Well Field Recycling	None	None	Mining Conservation (Recycling)
Steam Electric	Pecos Valley Aquifer	2,352	2,352	None

Table 5E- 86
Unmet Needs in Ward County
-Values are in Acre-Feet per Year-

Water User Group	2020	2030	2040	2050	2060	2070
Steam Electric Power	2,352	2,352	2,352	2,352	2,352	2,352

5E.32 Winkler County



Winkler County is almost entirely supplied by groundwater. Most of the supply originates from the Dockum, Pecos Valley, and Edwards Trinity Plateau aquifers. There are no water user identified shortages in Winkler County. There is over 30,000 acre-feet per year of groundwater in Winkler County that is not currently developed and could be used for strategies. Some of this water is planned for development by CRMWD for use outside of the county.

Winkler County has ample supply to meet the projected demands. Total demands for the county are less than 9,000 acre-feet per year. However, there are additional demands on the county's groundwater resources from development of Midland's T-Bar Ranch Well Field and the future development of CRMWD's Well Field. Even with these outside demands, there are sufficient supplies to meet them. Kermit, Wink, County Other, irrigation, and mining have no identified shortages but it is still recommended that they employ conservation strategies as appropriate. Livestock has no needs or recommended strategies.

5E.32.1 Winkler County Summary

Table 5E- 87
Winkler County Summary

Water User Group	Current Supplies	2020 Shortage (ac-ft/yr)	2070 Shortage (ac-ft/yr)	Recommended Water Management Strategies
Kermit	Dockum Aquifer	None	None	Municipal Conservation
Wink	Edwards-Trinity-Plateau and Pecos Valley Aquifers	None	None	Municipal Conservation
County Other	Dockum Aquifer, Edwards-Trinity-Plateau and Pecos Valley Aquifers	None	None	Municipal Conservation
Irrigation	Edwards-Trinity-Plateau and Pecos Valley Aquifers	None	None	Irrigation Conservation
Livestock	Dockum Edwards-Trinity-Plateau and Pecos Valley Aquifers, Livestock Local Supplies	None	None	None
Manufacturing	Dockum Aquifer	None	None	None
Mining	Dockum Aquifer, Edwards-Trinity-Plateau and Pecos Valley Aquifers	None	None	Mining Conservation (Recycling)
Steam Electric	----	----	----	----

5E.33 Region F Water Management Strategies Summary

5E.33.1 Unmet Needs Summary

There are some instances in Region F where the recommended water management strategies do not represent enough additional supply to meet the demand associated with the water user group. Table 5E- 88 summarizes all of the remaining unmet needs in Region F. Although there are unmet needs being shown as remaining within Region F, each need is accounted for within the overall plan and is in compliance with state requirements. Chapter 6 discusses the unmet needs in detail and explains how the unmet needs remain in consistency with the long-term protection of the state's resources as embodied in the guidance principles.

Table 5E- 88
Unmet Needs Summary

Water User Group	County	2020	2030	2040	2050	2060	2070
Andrews	Andrews	147	361	619	1,186	1,850	2,650
County Other	Andrews	16	43	74	134	192	254
Livestock	Andrews	9	17	25	39	50	60
Manufacturing	Andrews	31	59	87	134	174	209
Irrigation	Andrews	681	3,651	5,260	6,352	7,275	8,097
Mining	Andrews	909	868	66	0	0	0
Irrigation	Brown	1,302	1,062	1,061	1,063	1,060	1,061
Irrigation	Irion	252	200	147	147	147	147
Mining	Irion	1,444	1,440	225	0	0	0
Irrigation	Kimble	970	837	784	784	784	784
Mining	Loving	3,381	3,381	2,543	1,427	699	762
Irrigation	Martin	0	0	2,392	3,346	6,004	7,844
Colorado City	Mitchell	0	115	126	137	150	164
Irrigation	Mitchell	1,328	1,602	1,507	1,389	1,310	1,226
Steam Electric Power	Mitchell	8,656	8,670	8,684	8,698	8,712	8,726
Irrigation	Scurry	6,153	5,799	5,582	5,579	5,577	5,580
Mining	Scurry	222	363	385	290	196	132
Steam Electric Power	Ward	2,352	2,352	2,352	2,352	2,352	2,352
TOTAL		**27,853**	**30,820**	**31,919**	**33,057**	**36,532**	**40,048**