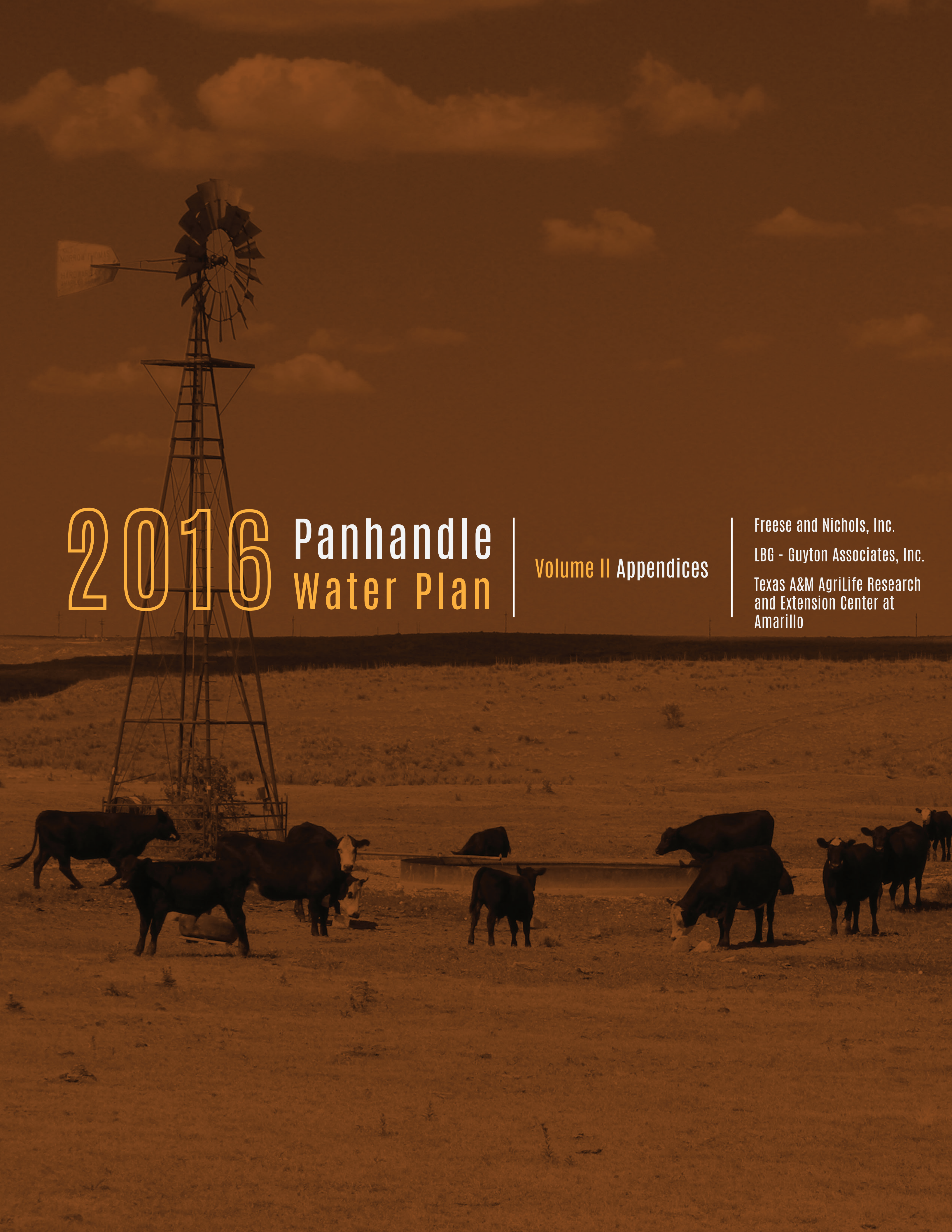

2016 Panhandle Water Plan

Volume II Appendices

Freese and Nichols, Inc.

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Texas A&M AgriLife Research and Extension Center at Amarillo

APPENDICES

Appendix A

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Appendix B

2016 Panhandle Regional Water Plan Task 2 Report: Agricultural Water Demand Projections

2016 Panhandle Regional Water Plan Task 2 Report: Agricultural Water Demand Projections

Thomas Marek, Steve Amosson, and Bridget Guerrero[1]

Water use by the agricultural sector accounts for approximately 90% of total water use within Region A, making accurate projection of water demands essential to the water planning process. Review of the proposed agricultural water use estimates by the Texas Water Development Board (TWDB) for Region A resulted in a decision to revise the estimates due to the relatively large and increased difference with those of the 2011 regional water plan (RWP) values. The preliminary agricultural estimates by the TWDB for Region A suggest a 28.8% and 39.5% increase in water use by irrigated crops and livestock, respectively, in 2020. This result is an estimated annual difference in water demand of over 400,000 ac-ft. (377,915 and 22,800 ac-ft. for irrigation and livestock, respectively). Compounding that increased difference over a 50-year horizon posed serious concern as to remaining aquifer resource availability in future years and as to whether regional groundwater districts could meet their desired future conditions (DFC).

The systemic problem may lie in the TWDB's attempt to make one methodology fit all of the state which fails to account for the unique utilization characteristics within the region and local knowledge of the planning group. It is recognized that the TWDB does not currently have access to agriculturally based ET network(s) for the most representative reference and crop ET demand data. Furthermore, Farm Service Agency (FSA) is used as the primary source for irrigated acreage data. A vast majority of irrigated acreage in the region is reported to FSA; however, there are large farms which are increasingly not participating in government support programs. Thus, these crop acreages are not being reported to FSA. Therefore, these operations' existence is only known through local contacts which are generally not known by TWDB personnel.

Given the importance of the agricultural water use projections to the regional water planning process, it was concluded that the original plan of work be expanded to include the development of the 2016 agricultural demand projections using the methodology developed and refined in Region A during the previous planning efforts to ensure accuracy of the estimates. The objective of this project task is to update agricultural water use estimates for Region A. The specific objectives are:

1. Identify and estimate water use of changing conditions in the irrigated cropping and livestock sectors that have emerged within the region since the 2011 RWP,
2. Update irrigated acreages, irrigation application data by producers and compile the latest average ET demand data to update the irrigation water use estimates,
3. Collect recent data on livestock inventories, develop anticipated livestock trends and update livestock water use by industry type, and
4. Revise and supply new agricultural demands for Region A to the regional planning committee.

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Irrigation Water Demand Estimates

The 2016 RWP irrigation estimates were developed using the TAMA model. The model is effectively a water balance model using the parameters of irrigation water pumped, crop ET, effective rainfall and soil profile water used within the respective crop growing seasons. The TAMA model is computed on a per crop per county basis and then summed over the regional counties (26) for the irrigation demand total.

The 2016 model utilized updated irrigated acreages from the FSA plus known non-FSA irrigated acreages within the region. These non-FSA acreages have increased over the last decade as producers are opting out of government support programs and regulatory/reporting issues. Current non-FSA acreage is over 83,000 acres within the region with some acreage presently outside groundwater conservation boundaries. The crop acreage basis was changed from that in the 2011 RWP using the average of years 2006 through 2008 to a more normal and longer record basis of years 2006 through 2010. Crop categories were also increased and acreage reallocated in regards to some crops as acreage increases have occurred and also shifted within the region since the 2011 RWP. The 12 crop categories in the 2016 TAMA model run include alfalfa, corn, cotton, hay, miscellaneous, pasture and other, peanuts, sorghum, forage sorghum, soybeans, sunflowers and wheat.

In northwest Hartley and southwest Dallam Counties, new irrigated land (largely held and undeveloped by the City of Amarillo) has been sold and is anticipated to be in full production by 2015. In Dallam County, 8,000 new acres and in Hartley County, 28,700 new acres of potato production will be irrigated within the miscellaneous crop category. This high crop value category will reflect priority irrigation for meeting full crop ET requirements. As this new operation requires crop rotation for sustained production, not all the new acreage was attributed to the miscellaneous category but split in a three year rotation with wheat for the other two years. This crop rotation lessens the potential irrigation demand impact of the new acreage since wheat requires less irrigation demand than vegetables (and has differing seasonal requirements). All new irrigated vegetable acreage was assumed to be operated under center pivot systems.

The applied crop ET percentage was increased by 2% for two crops due to the loss of the Texas High Plains ET network in 2010 resulting in producers periodically overwatering crops. The crop categories increased were corn (the largest regional crop category) and wheat (the second largest regional crop category). The 2011 RWP irrigation demand estimates contained a declining aquifer availability function (which relates to decreased irrigation system capacity per land area), the adoption of new technologies and the implementation of conservation pumping regulations over time. This function was also used in the 2016 TAMA demand model projections. The 2016 RWP irrigation demand estimates do not include or reflect the near record drought conditions and subsequently pumping demands of 2011.

Irrigated Acreage

Total regional irrigated acreage of 1,218,664 for 2020 in the 2011 RWP increased to 1,350,944 acres in the 2016 RWP (a 10.9% increase), Table 1. An analysis of FSA data indicated an increase in irrigated acreage of approximately 50,000 acres since the 2011 RWP. In addition, over 83,000 irrigated acres were identified as not being reported to FSA. Dallam and Hartley Counties have the largest irrigated acreage at 294,502 acres and 255,623 acres, respectively estimated in 2020. The updated acreage values account for the new vegetable production and rotational acreage in Dallam and Hartley Counties anticipated by 2015.

Table 1. Region A 2016 RWP irrigated crop acreage by county in 2020.

County	Total crop acreage (acres)
Armstrong	4,828
Carson	58,204
Childress	10,560
Collingsworth	36,854
Dallam	294,502
Donley	22,390
Gray	22,298
Hall	23,236
Hansford	132,913
Hartley	255,623
Hemphill	3,032
Hutchinson	35,520
Lipscomb	20,015
Moore	142,470
Ochiltree	59,634
Oldham	3,986
Potter	2,587
Randall	20,489
Roberts	5,633
Sherman	184,844
Wheeler	11,326
Total	1,350,944

Irrigated acreage by crop for the region is shown in Figure 1. Corn accounts for almost 40% of irrigated acreage at 533,158 acres. Wheat accounts for 35% of irrigated acreage at 473,104 acres. Cotton (121,158 acres), sorghum (88,505 acres), alfalfa (27,449 acres), pasture and other (27,267 acres), miscellaneous (24,774 acres), sorghum forage (19,225 acres), peanuts (14,634 acres), soybeans (10,499 acres), sunflowers (9,969 acres), and hay (1,200 acres) account for the remaining 25% of irrigated acreage.

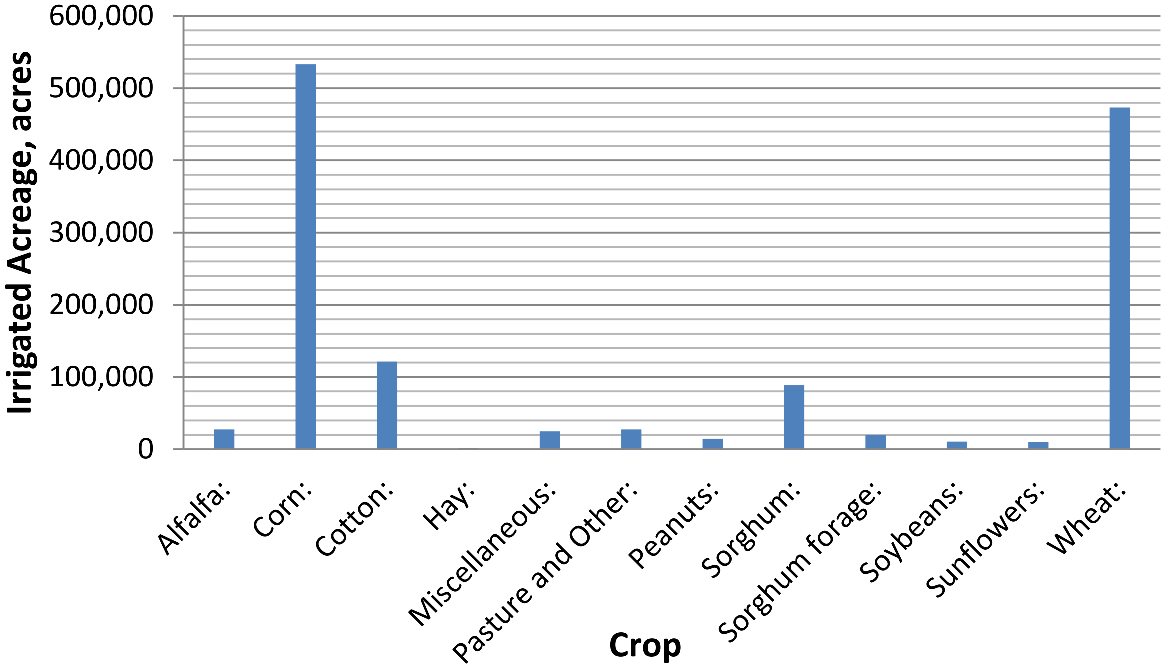

Figure 1. Region A 2016 RWP irrigated acreage by crop in 2020.

2016 RWP Irrigation Demand Estimates

The irrigation water demand of 1,311,372 ac-ft annually in the 2011 RWP for 2020 increased in the 2016 RWP to 1,513,469 ac-ft. annually for 2020. This value represents a 13.4% demand increase and accounts for the new and non-FSA county acreages. The projected 2020 to 2070 irrigation water demand estimates are shown in Table 2 and Figure 2. The counties with the largest irrigation demand are Dallam, Hartley, and Sherman Counties. These counties also exhibit a significant change in estimated irrigation demand from the 2011 RWP.

Table 2. Region A 2016 RWP estimated irrigation water demand by county for selected years (ac-ft).

County	2020	2030	2040	2050	2060	2070
Armstrong	4,194	3,999	3,789	3,368	2,947	2,526
Carson	55,702	50,339	*47,689*	*40,337*	37,092	31,793
Childress	7,308	6,511	6,169	5,483	4,798	4,112
Collingsworth	17,943	17,086	16,187	14,388	12,590	10,791
Dallam	369,864	344,388	326,263	290,011	253,760	217,509
Donley	24,080	22,496	21,312	18,944	16,576	14,208
Gray	21,291	20,330	19,260	17,120	14,980	12,840
Hall	10,134	8,450	8,005	7,116	6,226	5,337
Hansford	134,902	130,548	123,677	109,935	96,193	82,451
Hartley	345,365	294,013	278,538	247,590	216,641	185,692
Hemphill	1,907	1,589	1,506	1,339	1,171	1,004
Hutchinson	40,008	38,669	36,634	32,564	28,493	24,423
Lipscomb	20,009	19,225	18,213	16,189	14,166	12,142
Moore	143,028	137,390	130,159	115,697	101,234	86,772
Ochiltree	57,243	54,456	51,589	45,857	40,125	34,393
Oldham	3,937	3,557	3,370	2,995	2,621	2,246
Potter	3,427	2,633	2,495	2,217	1,940	1,663
Randall	18,000	17,370	16,456	14,627	12,799	10,971
Roberts	5,958	5,669	5,371	4,774	4,177	3,581
Sherman	220,966	212,269	200,042	178,753	156,409	134,064
Wheeler	8,203	8,113	7,686	6,832	5,978	5,124
Total (ac-ft.)	**1,513,469**	**1,399,100**	**1,324,410**	**1,176,136**	**1,030,916**	**883,642**

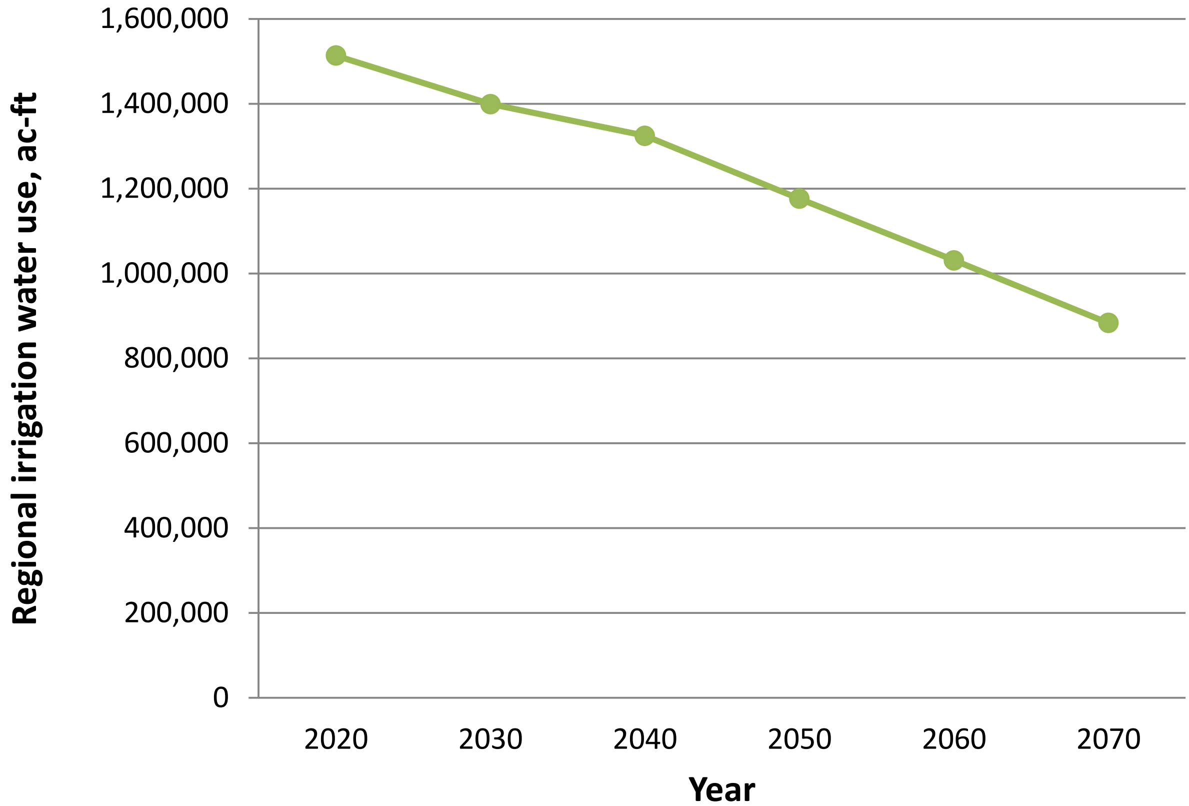

Figure 2. Region A 2016 RWP estimated regional irrigation water demand for selected years, ac-ft.

The regional water use per crop is illustrated in Figure 3. Corn has the highest demand for irrigation water estimated at over 912,202 ac-ft in 2020. Wheat is the second largest user due to the large amount of acreage grown in the region with 241,874 ac-ft. Combined, the remainder of the crops account for 359,393 ac-ft (or less than 24%) of the estimated irrigation water demand in 2020.

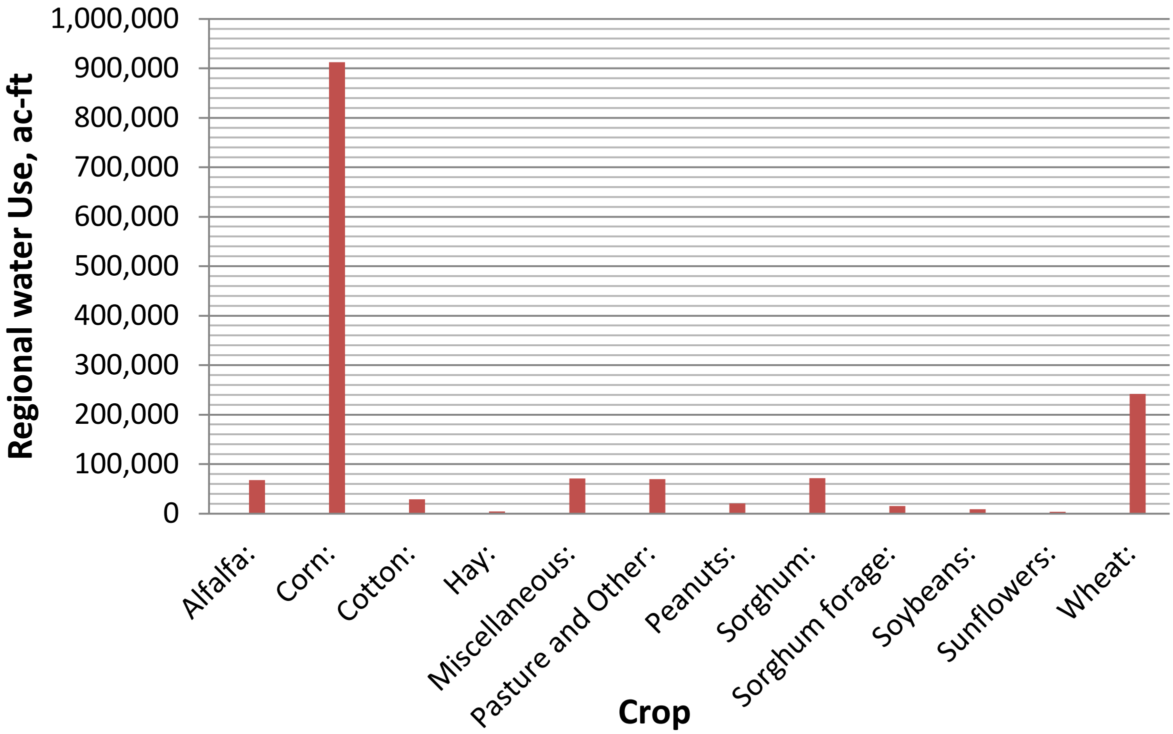

Figure 3. Region A 2016 RWP regional water use by crop in 2020.

The regional weighted water use per acre is shown in Figure 4. On average, water use per acre by crops trends downward over the 50-year time horizon. This is due in part to more efficiency in irrigation application, increasing limitations to irrigation system capacities and advances in technology. In addition, the reduction of water availability implies that some shifting in the crop composition will happen in the future within the region to more crops with lower water requirements.

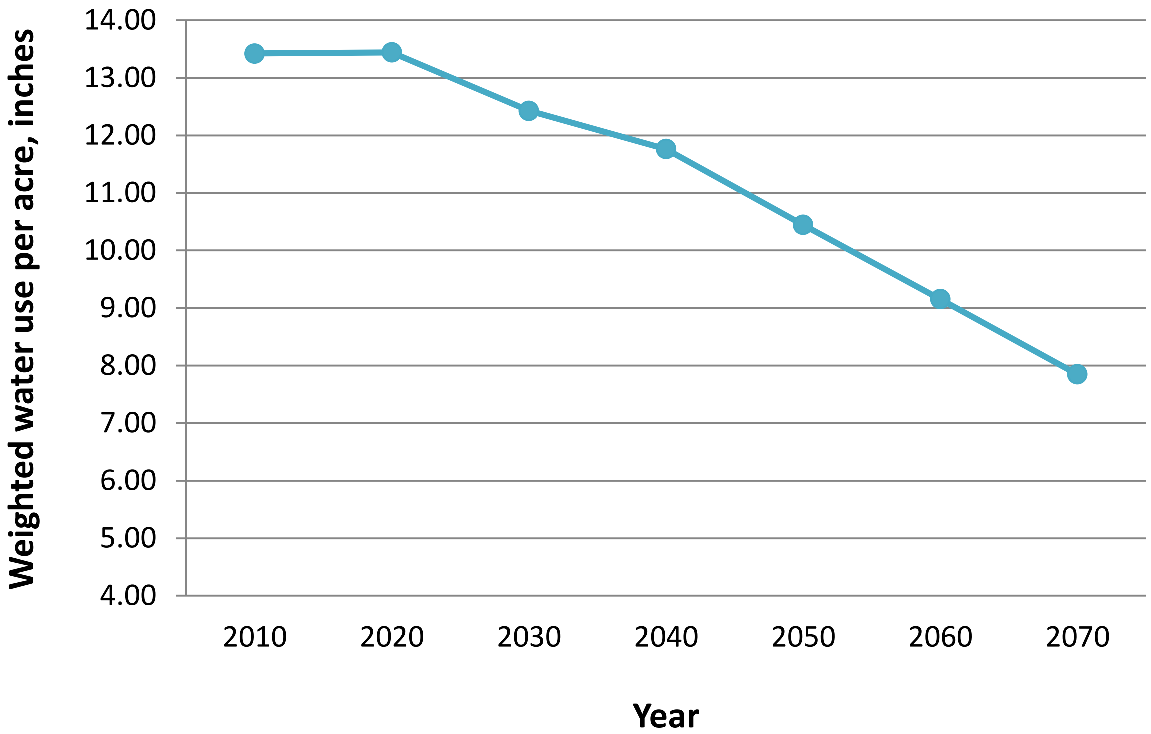

Figure 4. Region A 2016 RWP weighted (by crop) irrigation water use per acre.

<u>Region A 2011 RWP and 2016 RWP Irrigation Water Use Comparison</u>

A comparison of projected total irrigation water use in the 2011 RWP and the 2016 RWP are presented graphically in Figure 5. The 2016 RWP annual water use estimates by 2060 are estimated to be over 9% more than those made during the 2011 RWP process. This increase in anticipated water use can be primarily attributed the increase in irrigated acreage within the region.

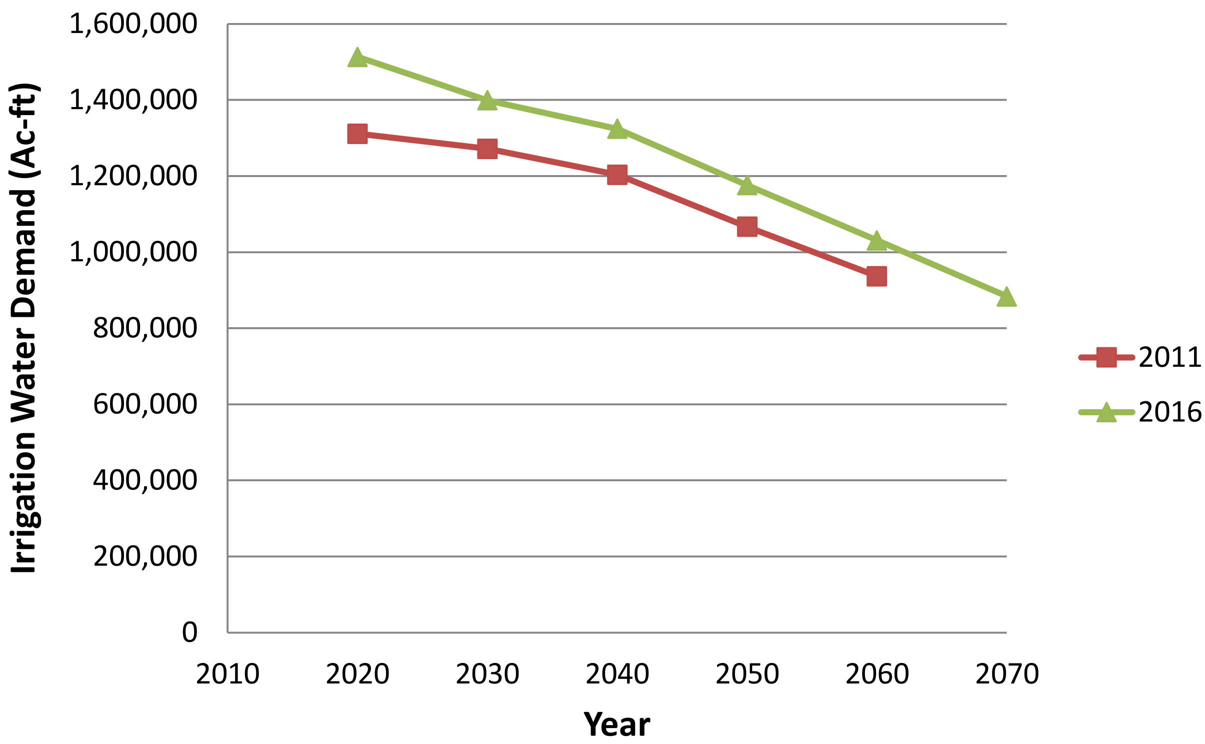

Figure 5. Region A comparison of estimated irrigation demand between 2011 RWP and 2016 RWP for selected years.

The estimated irrigation demand for Region A projected for 2020 by county coming from the 2011 RWP, proposed 2016 RWP and 2016 TWDB efforts are presented in Table 3. The initial TWDB estimates indicate that in 2020 a 28.82% increase in irrigation demand will occur compared to the 2011 RWP projection for the region whereas, the updated 2016 projections suggest the increase will occur but will be less (15.41%). The difference between the 2016 TWDB and the updated 2016 RWP projections in 2020 amounted to 175,818 ac-ft. An examination of the detailed irrigation demand data used in formulating the Region A 2016 TWDB agricultural water use estimates indicates that potential errors were made in the current methodology and data used. Several problems in the detailed TWDB 2016 Region A projections were found with unexplainable variations in water use: from county to adjacent county; year to year; between crops; and sometimes crop use estimates appear unrealistic. If the 83,000 irrigated acres which were identified outside of the FSA records and incorporated into the 2016 RWP projections had also been utilized in the TWDB estimates, the difference in the projected 2020 irrigation demand would have increased approximately 100,000 ac-ft.

Table 3. Comparison of 2011 RWP, 2016 RWP and 2016 TWDB estimates of irrigation demand by county for 2020.

	2020 Estimate (ac-ft.)			% Difference		
	2011 RWP	2016 RWP	2016 TWDB	2011 RWP vs. 2016 RWP	TWDB vs. 2011 RWP	TWDB vs. 2016 RWP
Armstrong	4,688	4,194	6,059	-10.54%	29.24%	44.47%
Carson	49,230	55,702	63,657	13.15%	29.31%	14.28%
Childress	5,519	7,308	9,542	32.42%	72.89%	30.57%
Collingsworth	21,907	17,943	38,669	-18.09%	76.51%	115.51%
Dallam	283,315	369,864	377,737	30.55%	33.33%	2.13%
Donley	29,676	24,080	29,226	-18.86%	-1.52%	21.37%
Gray	20,410	21,291	28,259	4.32%	38.46%	32.73%
Hall	10,731	10,134	17,185	-5.56%	60.14%	69.58%
Hansford	115,027	134,902	132,095	17.28%	14.84%	-2.08%
Hartley	281,648	345,365	336,179	22.62%	19.36%	-2.66%
Hemphill	1,705	1,907	6,117	11.85%	258.77%	220.77%
Hutchinson	39,971	40,008	41,545	0.09%	3.94%	3.84%
Lipscomb	15,546	20,009	27,232	28.71%	75.17%	36.10%
Moore	135,001	143,028	204,936	5.95%	51.80%	43.28%
Ochiltree	51,839	57,243	59,331	10.42%	14.45%	3.65%
Oldham	3,914	3,937	6,484	0.59%	65.66%	64.69%
Potter	5,697	3,427	5,132	-39.85%	-9.92%	49.75%
Randall	19,900	18,000	22,648	-9.55%	13.81%	25.82%
Roberts	5,639	5,958	11,068	5.66%	96.28%	85.77%
Sherman	200,521	220,966	254,134	10.20%	26.74%	15.01%
Wheeler	9,488	8,203	12,052	-13.54%	27.02%	46.92%
Total	1,311,372	1,513,469	1,689,287	15.41%	28.82%	11.62%

Livestock Water Demand Estimates

It was estimated in the 2011 RWP that livestock operations accounted for 2% to 3% of the water use in Region A. The anticipated rapid growth of the livestock industry makes on-going monitoring of this sector relevant. Given the importance of livestock to the region's economy, an objective of the 2016 RWP is to review/revise/modify, where necessary, regional livestock water use projections. Specific objectives were to:

1. Revise livestock inventory estimates for 2010 used in the 2011 RWP given current inventories,
2. Review/revise, where necessary, future livestock growth projections though 2070, and
3. Review/revise, where necessary, water use estimates per species.

Livestock Inventory Estimates

Livestock inventories by species were estimated for each county of Region A for 2000 in the 2006 RWP effort. County determination of livestock numbers is vital to the accurate estimation of water use. As in previous efforts, eight livestock water use groups were evaluated. They include beef cows, fed beef, summer stockers, winter stockers, dairy cattle, equine, swine and poultry. The procedure developed in previous planning efforts was utilized to develop the estimates of 2010 county level inventories by species.

In the 2016 RWP, updated inventory projections were estimated and utilized to replace 2010 inventory projections made in the 2011 RWP to improve the accuracy of the base for making future projections. Texas Agricultural Statistics Service was used as the primary source of livestock inventory estimates. However, TASS does not provide county level livestock inventory estimates for all species. In some species, only crop reporting district or state level estimates are made. In these instances, other sources of information including the 2007 Census of Agriculture, Extension or industry specialists, and advisory groups were used to refine/improve county level estimates.

Beef Cows

TASS inventory estimates of 2010 beef cow numbers by county were assumed to be equal to the 2010 inventories.

Fed Beef

TASS only estimates fed beef by inventories on a crop reporting district basis. In the 2011 RWP Texas Cattle Feeders Association (TCFA) personnel made the county level fed cattle estimates in consultation with the regional livestock advisory committee. In the 2016 RWP, TCFA personnel updated county level feedlot inventories via secondary data and personal communications with feedlot managers.

Summer Stockers

The procedure for estimating the number of summer stockers was revisited and refined. In the 2011 RWP, the number of summer stockers in a county was adjusted depending on the change in beef cow inventory. The cropland used for the grazing purposes in this category was identified via the 2007 Census of Agriculture and stocking rate on that acreage was doubled to reflect its improved grazing capacity relative to typical pastureland. The same procedure was followed in the 2016 RWP estimates with the summer stocker calculations being updated based on the 2010 beef cow inventories. Stocker estimates were reduced 10% to allow for frictional losses in inventories associated with under stocking.

Winter Stockers

A decrease in the number of stocker cattle grazing wheat has been observed over the last five years. A survey of Texas AgriLife County Extension Agents in the major wheat producing counties was conducted to ascertain changes in wheat pasture grazing. Based on the survey, the percentage of irrigated and dryland wheat assumed to be grazed, on average, was reduced to 60% and 20%, respectively. In the 2016 RWP, winter stocker numbers were adjusted to reflect the new wheat crop acreage base (2006 – 2010 average). These changes in winter stockers were reflected in the 2010 estimated inventory.

Dairy Cattle

County level dairy inventories were identified through TASS for 2010. In counties with less than three dairies which are not reported in TASS data, Industry sources were utilized to identify herd sizes where possible. Residual dairy cows not accounted for were divided evenly between counties where dairies exist but herd sizes were unknown.

Equine

The 2007 Census of Agriculture was used as the source for county level equine estimates. Currently, it is the only source of this data by county.

Swine

In the 2011Water Plan, these companies were surveyed directly in the winter of 2009 with the assistance of the Texas Pork Producers Association to determine the actual inventories to use in the 2011 RWP effort. The 2007 Census of Agriculture was utilized to estimate inventories in counties without commercial scale operations. Inventory estimates were adjusted in the 2016 RWP based on the reductions in the 1-N inventories compared to the 2011 RWP estimates. In estimating the current inventories, it was assumed all hog numbers had remained unchanged from the previous plan with the exception of Dallam County where Premium Standard Farms (PSF) was in the process of closing their operation. Therefore, all reductions in inventory were assumed to occur in Dallam County. In addition, 2020 inventories in Dallam County were modified to reflect the final closure of PSF and the plans of the new operation that is replacing PSF.

Poultry

Virtually no poultry currently exists within Region A. In the 2011 RWP, 2010 inventory numbers were arbitrarily set at 1,000 birds per county. In the 2016 RWP, these 2010 county level inventories were replaced with 2007 Census of Agriculture county level estimates.

Livestock Growth Projections

Revising the projected growth rate from the 2011 RWP was beyond the scope of this Task. Projected growth rates developed in consultation with industry groups during the 2011 RWP were assumed to apply to the 2016 RWP projections (Table 4). However, one modification was made. At the request of TCFA personnel, the start of projected growth (Dallam, Hansford, Hartley, Moore, Ochiltree, and Sherman Counties) was delayed from 2020 to 2030 and the rate of growth for the remainder of the time horizon in those counties was reduced from 10% per decade to 5% per decade.

Table 4. Region A 2011 RWP and 2016 RWP projected livestock inventory growth by species, 2010 – 2070.

Species	2011 RWP	2016 RWP
(---------- Annual Growth Rates ----------)		
Beef Cows:		
2010 – 2070	0.00%	0.00%
Fed Beef:		
2010 – 2070	10% growth per decade in Dallam, Hansford, Hartley, Moore, Ochiltree, and Sherman Counties. No growth in other counties.	5% growth per decade starting in 2030 in Dallam, Hansford, Hartley, Moore, Ochiltree, and Sherman Counties. No growth in other counties.
Summer Stockers:		
2010 - 2070	0.00%	0.00%
Winter Stockers:		
2010 - 2070	0.25%	0.25%
Dairy Cattle:		
2010 - 2020	In 2020, 60,000 cows allocated to Dallam, Hartley, Moore and Sherman Counties based on percentage of TCEQ permits	In 2020, 60,000 cows allocated to Dallam, Hartley, Moore and Sherman Counties based on percentage of TCEQ permits
2030 - 2070	1.00% annual growth rate in all dairy counties.	1.00% annual growth rate in all dairy counties.
Equine		
2010 - 2070	1.00%	1.00%
Poultry:		
2010 - 2070	In 2020, add 1,000,000 capacity operations in Armstrong, Carson, Childress, Collingsworth, Gray, Oldham, and Wheeler Counties. No other growth is assumed.	In 2020, add 1,000,000 capacity operations in Armstrong, Carson, Childress, Collingsworth, Gray, Oldham, and Wheeler Counties. No other growth is assumed.
Swine:		
2010 - 2020	0.00%	Dallam County inventory scaled up to reflect new operation. 0.00% growth in other counties
2030 - 2070	0.00%	0.00%

Inventory Projection Summary

A summary of the impacts of changes in livestock inventories and future projections utilized in the 2016 RWP compared to the 2011 RWP is given in Table 5. In this table, a comparison of inventories is made during 2010 and 2060. In addition, the final 2070 inventory projection in the 2016 RWP is presented. The 2010 inventories were changed in 2016 RWP to reflect current inventories that were estimated based on 2009 data. Projected growth rates were altered to account for changing industry conditions. The 2016 RWP inventories (2060) of fed beef are expected to be more than 300,000 lower than the 2011 RWP due to delayed and reduced growth rates while dairy cow numbers are projected to be 15,000 cows higher than the 2011 RWP estimates. The most significant change in inventory projections was in the swine industry where ending inventory was dropped more than 660,000 head. This decrease can be traced to the demise of Premium Standard Farms (PSF) and a planned reduction in an existing operation. The replacement of PSF with a planned smaller operation is reflected in the projections.

Table 5. Region A 2010, 2060, and 2070 inventories by species for 2011 and 2016 RWPs.

Species	2011 RWP 2010	2016 RWP 2010	2011 RWP 2060	2016 RWP 2060	2016 RWP 2070
	(---------- Number of Head ----------)				
Beef Cows	251,000	250,900	251,000	250,900	250,900
Fed Beef	1,312,739	1,341,809	1,854,972	1,536,932	1,591,960
Summer Stockers	368,921	338,985	368,921	338,985	338,985
Winter Stockers	467,971	430,927	530,198	488,228	500,572
Dairy Cattle	49,137	57,000	162,490	177,328	195,881
Equine	16,882	16,035	26,372	26,372	29,131
Poultry	21,000	6,805	7,014,000	7,005,739	7,005,739
Swine	1,182,371	710,000	1,093,971	431,557	431,557

Livestock Water Use by Species

Significant time and effort was made in the 2011 RWP to form advisory committees consisting of industry experts to review water use estimates by species. The estimates developed by the committees were implemented in the 2016 RWP, Table 6. These estimates were assumed to still hold and were used in developing livestock water use projections in the 2016 RWP. However, water use in Dallam County swine operations was modified to reflect a different herd composition resulting from a change in ownership and focus of its primary hog operation.

Table 6. Region A 2016 RWP livestock water use estimates per animal.

Species	2016 RWP (gal/day)
Beef Cows	20
Fed Beef	12.5
Summer Stockers	10
Winter Stockers	8
Dairy Cattle	55
Equine	12
Poultry	0.09
Swine	2.5 – 8.2

<u>Livestock Projected Water Use</u>

Region A annual livestock water use projections by county for selected years during the 2016 RWP over a 60-year horizon are presented in Table 7 and is illustrated by county for 2070 in Figure 6. Overall, water use in the Region A livestock sector is predicted to increase 28.5% from 37,799 ac-ft. usage in 2010 to 48,564 ac-ft. in 2070. While this increase is significant, it still will only represent approximately five percent of the total agricultural water use within the region during 2070. Six counties (Hartley, Dallam, Moore, Sherman, Hansford, and Ochiltree) account for nearly 68% of the livestock water use during 2070. These six counties are characterized by extensive fed beef operations in conjunction with significant sized dairy and/or swine operations.

Table 7. Region A 2016 RWP estimated livestock water use by county for selected years.

County	2010	2020	2030	2040	2050	2060	2070
Armstrong	541	645	649	652	656	659	663
Carson	588	692	696	700	704	709	713
Childress	388	490	493	495	497	500	503
Collingsworth	497	600	603	605	608	611	614
Dallam	4,739	4,437	4,669	4,920	5,191	5,485	5,803
Donley	1,329	1,330	1,332	1,333	1,335	1,337	1,339
Gray	1,249	1,352	1,378	1,407	1,438	1,473	1,511
Hall	335	336	337	339	340	341	343
Hansford	3,425	3,432	3,574	3,724	3,881	4,046	4,219
Hartley	4,676	6,498	6,977	7,498	8,066	8,684	9,359
Hemphill	1,270	1,275	1,279	1,284	1,289	1,295	1,302
Hutchinson	843	847	873	903	935	971	1,010
Lipscomb	945	947	969	993	1,020	1,050	1,083
Moore	3,021	3,676	3,906	4,155	4,424	4,716	5,032
Ochiltree	4,769	4,216	3,632	3,729	3,832	3,942	4,058
Oldham	1,126	1,229	1,231	1,234	1,237	1,240	1,243
Potter	479	481	482	484	486	488	491
Randall	2,646	2,654	2,665	2,677	2,690	2,704	2,719
Roberts	368	369	369	370	371	372	373
Sherman	2,990	3,449	3,631	3,825	4,034	4,257	4,497
Wheeler	1,575	1,577	1,680	1,682	1,684	1,687	1,689
Total	**37,799**	**40,532**	**41,425**	**43,009**	**44,718**	**46,567**	**48,564**

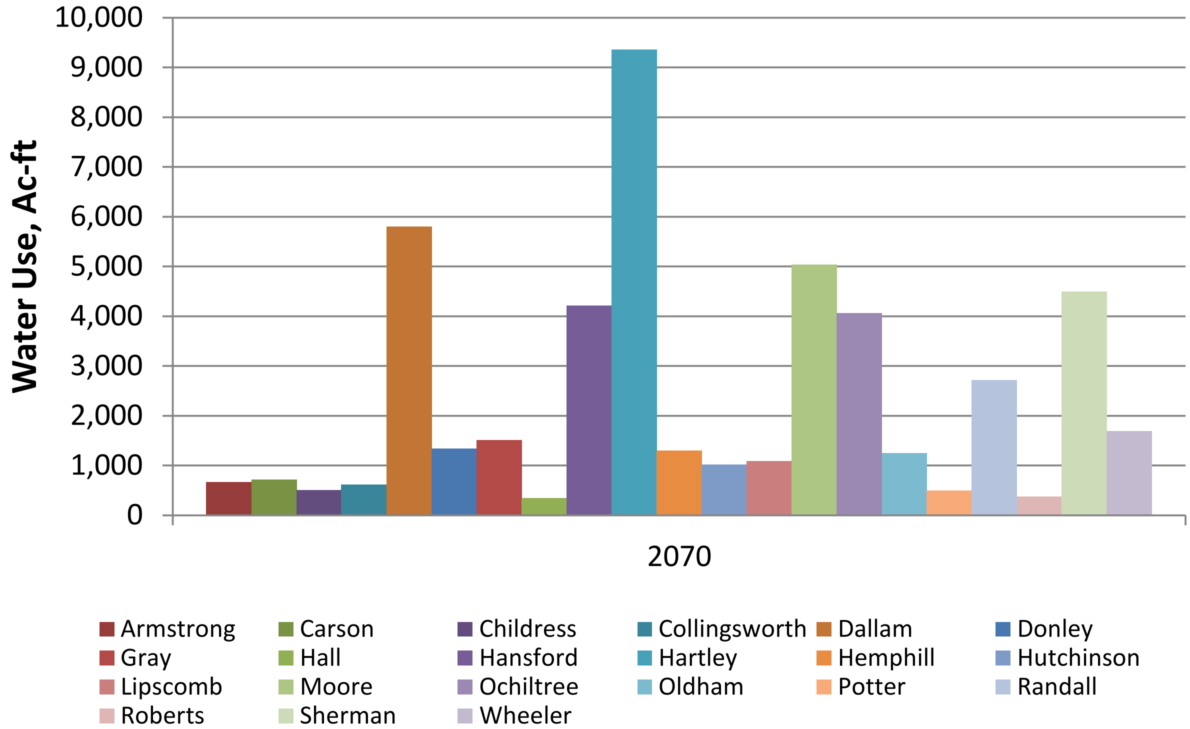

Figure 6. Region A 2016 RWP estimated livestock water use by county, 2070.

The largest livestock water use group is projected to be the fed cattle industry with an annual usage of 22,290 ac-ft. per year by 2070, Table 8. The anticipated expansion of the dairy industry will make it the second largest user group by 2070 (12,067 ac-ft. per year). These two user groups account for 71% of projected livestock water use in 2070. Beef cows, winter & summer stockers and swine are all projected to use more than 3,000 ac-ft. per year with estimated demand of 5,620, 4,400 and 3,086 ac-ft., respectively. Poultry and equine accounted for slightly more than two percent of the projected livestock water consumption in 2070.

Table 8. Region A 2016 RWP livestock water use by species for selected years.

Species	2010	2020	2030	2040	2050	2060	2070
Fed Cattle	18,787	18,787	19,421	20,087	20,786	21,520	22,290
Beef Cows	5,620	5,620	5,620	5,620	5,620	5,620	5,620
Stockers	4,140	4,181	4,222	4,265	4,309	4,354	4,400
Dairy Cows	3,641	7,337	8,105	8,953	9,890	10,924	12,067
Swine	5,393	3,761	3,086	3,086	3,086	3,086	3,086
Horses	215	238	263	290	320	354	391
Poultry	1	605	706	706	706	706	706
Total	37,797	40,529	41,423	43,007	44,717	46,564	48,560

Region A 2011 RWP, 2016 RWP and 2016 TWDB Livestock Water Use Comparison

Projected total livestock water use in the 2011 RWP and the 2016 RWP are presented graphically in Figure 7. The 2016 RWP annual water use estimates by 2060 are estimated to be approximately 12.6% less than those made during the 2011 RWP process. This drop in anticipated water use can be attributed basically to two factors. First and foremost, the revision downward in swine inventory projections due to the closure of Premium Standard Farms. Second, the delay in implementing growth rates (2020 to 2030) and the reduction in anticipated decadal growth rate (10% to 5%) resulted in a relative decrease in fed beef inventory of 300,000+ by 2060. This modification was made at the request of TCFA personnel to reflect changing conditions within the industry.

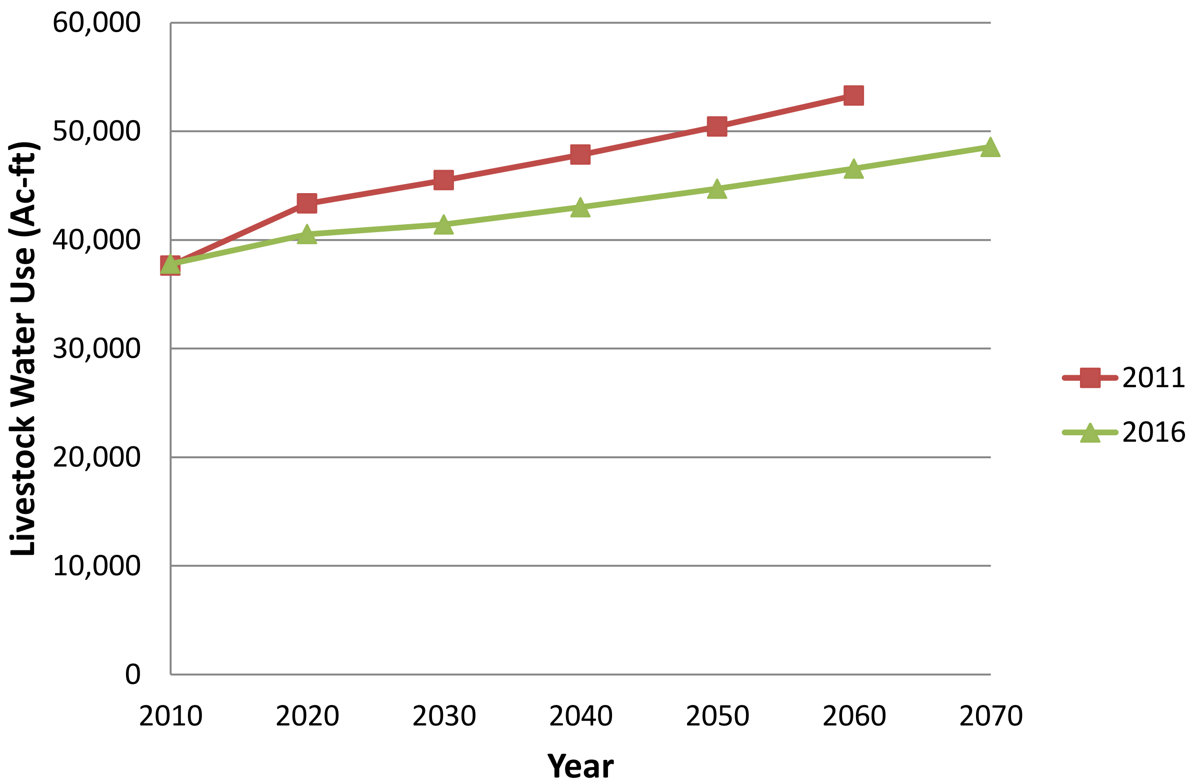

Figure 7. Region A comparison of estimated livestock water use between 2011 RWP and 2016 RWP for selected years.

The estimated livestock water use projected for 2020 by county emanating from the 2011 RWP, proposed 2016 RWP and 2016 TWDB efforts are presented in Table 9. The initial TWDB estimates suggest a 39.50% increase in livestock water use consumption compared to the 2011 RWP projection for the region and an even greater increase (49.19%) relative to the updated projections made as a part of the 2016 RWP. Differences between the 2016 TWDB and the updated 2016 RWP estimates can be traced to several factors and the TWDB estimates are believed to be excessive. These factors include: a double accounting error in some cases that resulted in an overestimation of water use in the fed beef sector; increased water use by species (fed cattle, dairy cows and hogs) over the numbers developed and documented in the 2011RWP effort which accounted for the unique characteristics of regional operations; and unawareness of changing conditions that have occurred which include the closure of the swine operation (PSF) and the revision of future growth rates in the fed beef industry.

Table 9. Comparison of 2011 RWP, 2016 RWP and 2016 TWDB estimates of livestock water demands by county for 2020.

	2020 Estimate (ac-ft.)			% Difference		
	2011 RWP	2016 RWP	2016 TWDB	2011 RWP vs. 2016 RWP	TWDB vs. 2011 RWP	TWDB vs. 2016 RWP
Armstrong	670	645	871	-3.73%	30.00%	35.04%
Carson	711	692	832	-2.67%	17.02%	20.23%
Childress	470	490	444	4.26%	-5.53%	-9.39%
Collingsworth	564	600	653	6.38%	15.78%	8.83%
Dallam	4,654	4,437	11,605	-4.66%	149.36%	161.55%
Donley	1,268	1,330	1,078	4.89%	-14.98%	-18.95%
Gray	1,451	1,352	2,385	-6.82%	64.37%	76.41%
Hall	330	336	333	1.82%	0.91%	-0.89%
Hansford	3,956	3,432	5,632	-13.25%	42.37%	64.10%
Hartley	7,103	6,498	9,341	-8.52%	31.51%	43.75%
Hemphill	1,281	1,275	1,557	-0.47%	21.55%	22.12%
Hutchinson	689	847	648	22.93%	-5.95%	-23.49%
Lipscomb	1,007	947	825	-5.96%	-18.07%	-12.88%
Moore	3,605	3,676	4,764	1.97%	32.15%	29.60%
Ochiltree	3,463	4,216	2,862	21.74%	-17.35%	-32.12%
Oldham	1,257	1,229	1,440	-2.23%	14.56%	17.17%
Potter	504	481	699	-4.56%	38.69%	45.32%
Randall	2,741	2,654	3,790	-3.17%	38.27%	42.80%
Roberts	385	369	419	-4.16%	8.83%	13.55%
Sherman	5,579	3,449	8,284	-38.18%	48.49%	140.19%
Wheeler	1,657	1,577	2,006	-4.83%	21.06%	27.20%
Total	43,345	40,532	60,468	-6.49%	39.50%	49.19%

Summary and Conclusions

The preliminary agricultural water use estimate by the Texas Water Development Board (TWDB) for Region A suggests a 28.8% and 39.5% increase in water use by irrigated crops and livestock, respectively, in 2020. This result is an estimated annual difference in water demand of over 400,000 ac-ft., (377,915 and 22,800 ac-ft. for irrigation and livestock, respectively), compared to the previous 2011 regional water plan (RWP) projections. A review of the TWDB estimates found several inconsistencies and a failure to take into account unique characteristics of the region. Therefore, the Region A Ag Demands subcommittee requested TAMU personnel to estimate the agricultural demands using the same methodology developed in previous planning efforts with adjustments being made to reflect changing conditions that have occurred in the region since the last planning cycle.

Review and revision of the Region A 2011 RWP irrigation demand estimates for the 2016 RWP indicate that new, additional irrigated acreage has increased the irrigation demand. The irrigation water demand of 1,311,372 ac-ft. annually in the 2011 RWP for 2020 increased in the 2016 RWP to 1,513,469 ac-ft. annually for 2020. This value represents a 13.4% demand increase and accounts for the new and non-FSA county acreages. The majority of the new acreage changes occurred in Hartley and Dallam Counties and is attributed to potato production. Other acreage related TAMA model impacts are non-FSA irrigated data operations known to exist within the region. The acreage basis also changed in the TAMA (Texas A&M-Amarillo) irrigation demand model to reflect the average of the years of 2006 through 2010, which is representative of a more normal distribution of years in regards to crop evapotranspiration (ET) demand and rainfall patterns, as compared to the 2006 to 2008 averages. These changed and new crop acreages and accompanying irrigation requirements have increased the total regional irrigation demand over the 2011 RWP estimates but represent the best available data to date. The new regional irrigation demand values are below the suggested TWDB estimates provided for consideration in Region A.

The 2016 RWP estimates indicate that livestock water demand will increase 28.5% from 2010 (37,800 ac-ft.) to 2070 (48,564 ac-ft.) primarily due to anticipated expansions in the fed beef and dairy industries. However, this is a decrease of 12.6% relative to the 2011 RWP projections when comparing 2060 estimates. Changing conditions in the swine and fed beef industries accounted for most of the relative decline. In Dallam County, Premium Standard Farms ceased operations and is being replaced by what is/will be replaced by a smaller operation. At the request of TCFA personnel, the start of projected growth (Dallam, Hansford, Hartley, Moore, Ochiltree, and Sherman Counties) was delayed from 2020 to 2030 and the rate of growth for the remainder of the time horizon in those counties was reduced from 10% per decade to 5% per decade.

Appendix C

Analyses for PWPA Surface Water Availability

MEMORANDUM

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SUBJECT: Documentation of Canadian River and Red River WAM Analyses for PWPA Water Availability

DATE: April 6, 2015, Updated October 26, 2015

PROJECT: PPC11456

This memorandum documents the datasets and processes used in the Water Availability Model (WAM) analyses for the Panhandle Water Planning Area (PWPA). The memorandum is organized into four sections, discussion of the modeling for Lake Meredith, Greenbelt Reservoir, Palo Duro Reservoir, and run-of-river supplies in the Canadian River and Red River Basin. The Texas Water Development Board in a letter to the Panhandle Water Planning Group (PWPG) dated October 29, 2012 approved the PWPG request to use extended hydrology datasets in calculating the yield of Lake Meredith in the Canadian River Basin. The letter approved the request that the 2070 yield for Palo Duro Reservoir be estimated by linear interpolation based on the yield analysis from the 2011 Panhandle Regional Water Plan for the decades 2020-2060. The letter also authorized the use of the findings from the Greenbelt Municipal and Industrial Authority's water study estimate for Greenbelt Reservoir in the Red River Basin.

The following table lists each major reservoir in Panhandle Water Planning Area (PWPA), including pertinent data relative to the water availability modeling.

Table C-1 Summary of Reservoir Water Right Information

Reservoir	Water Right	Priority Date	Diversion (Ac-ft/yr)	Authorized Impoundment (Ac-ft)
Meredith	CA 01-3782	Jan 30, 1956	151,200	904,000[1]
Palo Duro	CA 01-3803	Apr 23, 1974	10,460	60,900
Greenbelt	CA 02-5233	Aug 11, 1958	16,030[2]	59,100

[1] of which 9,111 ac-ft is reserved for compliance with the Red River Compact

[2] of which 4,030 ac-ft/yr is authorized diversion from Lelia Lake Creek run-of-river and 250 ac-ft/yr diverted directly from Salt Fork of the Red River.

1.1 Lake Meredith

Lake Meredith is a key component of water supply in the Texas Panhandle region. As such, estimation of the yield and reliability of Lake Meredith has been a significant component of prior planning cycles for the Panhandle Water Planning Area. Prior Regional Plans have relied upon the Full Authorization Run (Run 3) of the TCEQ-approved Canadian Water Availability Models (WAMs) to assess water availability for the lake in accordance with TWDB requirements. The 2006 Regional Plan included substantial revisions to model parameters and extension of historical hydrology datasets to capture more current portions of the hydrologic record than the original WAM. However, even this updated WAM does not fully capture recent portions of the ongoing critical drought. As such, an alternate methodology is required in order to estimate Lake Meredith yield for the 2016 Regional Plan.

Due to the constraints of the current planning cycle, a major update of the WAM is not feasible. As such, Lake Meredith yield analysis for the 2016 plan utilizes a Microsoft Excel-based Operate reservoir model. The Operate model incorporates hydrologic data such as inflow, net evaporation, water demands and priority releases, reservoir configuration, and other parameters to perform a monthly water balance on a single reservoir over a certain historical period. As with the TCEQ WAM, the Operate model is not a direct predictive model but rather a statistical tool analyzing reservoir behavior under a period of historical hydrology. While only examining one particular reservoir rather than the entire basin, the Operate model uses a similar conceptual approach to the WAM. Further, the lake's water right seniority and extremely minimal history of water rights releases supports the use of a focused, simplified model. This enables estimation of firm and safe yields for the reservoir for Regional Planning purposes.

Input parameters for the model were compiled from several sources. The Canadian River Basin WAM updated for the 2006 Regional Plan (Canadian2000 WAM) served as the primary reference, with substantial additional data from Canadian River Municipal Water Authority (CRMWA) records, TWDB records, and prior Regional Plans. The combination of sources used for the study allowed for simulation of historical hydrology for the reservoir site from 1940 through March 2012.

Development of input parameters for the model is discussed in Section 1.2 below, with model results following in Section 1.3.

1.2 Lake Meredith Model Input Development

Inputs for the monthly time step modeling of Lake Meredith were compiled from multiple sources due to the length of the historical period of the simulation and the availability of individual references. Where possible, information from the Canadian2000 WAM was utilized as the preferred dataset; this version of the Canadian River Basin WAM was updated during a prior round of Regional Water Planning and includes improved and extended hydrology datasets relative to the TCEQ WAM Run 3. However, the effective Canadian2000 simulation period is limited to January 1940 through September 2004. Thus, alternate data sources were evaluated for later time periods.

a) ***Inflows*** – Inflows (runoff) into Lake Meredith were determined by multiple methods for different date ranges of the historical simulation period. For January 1940 through September 2004, modeled inflows into the lake were extracted from the Canadian2000 WAM and applied directly. Prior to inflow extraction, the WAM was modified to include full permitted diversion targets for Lake Meredith and the Palo Duro reservoir.

   For October 2004 through March 2012, a water balance approach was required to estimate Lake Meredith inflows. Lake levels for this time period were available on a monthly basis from CRMWA records. The beginning and ending elevation for each month was used in conjunction with lake survey data to determine the estimated total volume change of the reservoir over the course of the month. CRMWA records of reservoir releases, lakeside diversions, and seepage, as well as estimates of monthly evaporation, were then summed with the volume change to determine estimated inflows to the reservoir. In cases where an individual monthly time step was not of sufficient resolution to estimate inflow accurately, generating a negative inflow estimate, inflow was estimated to be zero for that month with the cancelled negative volume distributed to adjacent months to preserve the overall mass balance. A comparison of this estimated inflow to CRMWA inflow estimates showed a good relationship (r^2 = 0.98) between estimated and observed data.

Reservoir inflows for the last ten to fifteen years of the hydrologic record show substantial decline relative to earlier years, corresponding with declining reservoir storage and the ongoing critical drought. A number of potential complicating factors to the drought have been proposed for the lake, including rainfall intensity patterns, declining groundwater levels, land use change, and climatic shifts. Regardless of the cause or causes of declining inflows, continuation or worsening of drought conditions would be expected to substantially impact reservoir yield. The extended inflows used in the model are shown in Table C-2.

b) ***Net reservoir evaporation*** – As with inflow data, monthly net evaporation was compiled from multiple sources. For the time period from January 1940 through September 2004, net evaporation depths were extracted from the Canadian2000 WAM. Since the Canadian2000 WAM does not include historical data subsequent to September 2004, values for the remainder of the desired simulation period were calculated from CRMWA evaporation and precipitation records; some CRMWA data was also used in development of the Canadian2000 WAM itself. The extended net evaporation is shown in Table C-3.

c) ***Area-Capacity-Elevation data*** – Data for the area-capacity-elevation properties of the reservoir were taken primarily from the volumetric survey of Lake Meredith performed by the Texas Water Development Board in June 1995 and published in March 2003. In addition to construction and survey history of the lake, the report includes tables of area and volume of the lake as a function of elevation. Based on a sedimentation rate of 0.088 ac-ft/mi^2/yr from this report and an incremental drainage area of 4,908 square miles below Ute Reservoir, estimated area-capacity-elevation properties were projected for future decades. Reservoir curves were generated for years 2010, 2020, 2040, and 2070. The area capacity curves for 2010 and 2070 are shown in Table C-4.

d) ***Releases*** – Reservoir releases from CRMWA records total 465 ac-ft since reservoir construction, with the last release occurring in 1999. Results of the Canadian2000 WAM do not show any modeled releases for senior rights. Due to the small volume and intermittent nature of past releases, they were not included in the modeling of the reservoir. No environmental flow releases were assumed.

e) ***Demand Pattern*** – Because the reliability models operate on a monthly time step, the annual water demand estimated for the reservoir must be distributed in twelve monthly increments. The monthly water demand distribution (percent of annual demand each month) was estimated as the average monthly distribution of lakeside diversions from CRMWA records for 2001 through 2010. Year 2011 and 2012 demands were not included due to the extreme situation impacting the reservoir at that time. Please note that the demand pattern generated from this ten-year period of CRMWA records is similar to the diversion distribution already included in the Canadian River WAM.

f) **Seepage** – Studies performed as part of the prior planning cycle note the potential for seepage losses for Lake Meredith, with such losses seeming to diminish with time; this corresponds with declining seepage estimates in CRMWA records. The development of the Canadian2000 WAM in the prior planning cycle included adjustment of naturalized flows due to seepage at the lake. As the inflows extracted from the model should already exclude any direct seepage or channel loss volumes, no seepage loss term was applied in the Excel-based model for January 1940 through September 2004. A seepage loss is included for October 2004 through March 2012 to account for losses in data extracted from the most recent water balance methodology. Seepage values were extracted from CRMWA records.

g) **Operating Range** – While Lake Meredith has a substantial potential storage capacity, several factors constrain the usable portion of the reservoir for Texas to a smaller volume. The lake's inactive pool elevation is 2,860 ft above mean sea level (MSL). Therefore, the model was constrained not to fall below this level during firm and safe yield estimation. In addition, the interstate Canadian River Compact limits the right of Texas to retain water in conservation storage in Lake Meredith to 500,000 ac-ft. While the initial permitted conservation pool elevation of the reservoir (2,936.5 ft MSL) corresponds to a volume in excess of 800,000 ac-ft, all but 500,000 ac-ft is for sedimentation and inactive storage. Because sedimentation in the reservoir has been limited and the reservoir has not exceeded a water surface elevation of 2,915 ft MSL, the model reflects the usable portion of the reservoir as the first 500,000 ac-ft above the inactive pool.

h) **Upstream Reservoir Impacts** – Ute reservoir in New Mexico is located on the Canadian River upstream of Lake Meredith and could conceivably impact inflows to Lake Meredith. Because model inflow data through September 2004 was extracted from the Canadian2000 WAM, which already includes full allowed Ute Reservoir diversions, no further adjustment to inflow was needed for that time period. An examination of flows at the USGS station downstream of Ute Reservoir indicated typically very low flows. There are occasional pulses, but fewer than for Lake Meredith inflows; additionally, there has only been one significant spill at Ute Reservoir since year 2000, which does not appear to have had substantial impact on Lake Meredith. For this reason, it appears that Ute Reservoir would have little impact on Lake Meredith yield. This is consistent with the approach taken in the Canadian2000 WAM.

i) **Starting Volume** – The Excel-based reservoir model used for this study was set to a starting volume equal to the maximum allowable storage of 500,000 ac-ft above the inactive pool. This was done to maintain consistency with the approach taken with the TCEQ WAM, which assumes that reservoirs are full at the beginning of the simulation.

Table C-2: Extended Inflow to Lake Meredith

-Values in Acre-Feet-

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	779	3,991	86	129	26,769	5,525	2,243	13,958	10,771	55	12,986	2,917
1941	2,396	3,370	2,878	2,336	419,139	371,586	321,780	174,760	480,405	424,777	54,545	28,618
1942	14,736	9,761	10,081	364,077	189,747	51,470	34,214	36,265	276,247	71,128	16,765	5,677
1943	30,109	1,687	743	1,642	2,076	177	26,671	0	0	153	324	4,754
1944	11,525	5,430	1,986	2,368	23,469	34,542	26,423	25,216	44,693	2,129	221	13,251
1945	9,567	1,822	1,103	319	36	2,495	0	23,206	4,341	10,100	54	58
1946	673	456	69	249	1,923	7,884	0	8,992	55,312	152,418	4,490	3,877
1947	5,112	388	4,714	4,890	34,846	3,385	12,067	0	96	324	247	353
1948	495	3,258	5,770	57	4,235	91,912	3,175	45,552	790	1,302	5,684	441
1949	569	2,152	1,620	2,651	119,681	97,403	70,930	32,177	16,895	2,541	2,302	655
1950	1,679	922	557	1,260	2,082	31,270	177,593	50,207	83,891	7,046	900	2,449
1951	3,554	5,503	2,245	1,115	75,406	19,480	27,017	2,794	2,313	718	3,648	1,102
1952	1,366	809	329	2,821	1,278	768	5,918	10,321	2,534	404	386	947
1953	2,874	977	793	481	277	2,117	28,598	22,447	119	13,261	956	1,137
1954	3,186	2,126	1,643	4,246	51,596	0	34,852	9,791	0	20,591	689	433
1955	1,071	922	441	27,530	72,103	28,994	11,829	11,563	6,382	3,111	542	527
1956	765	1,487	746	501	36,215	4,941	3,776	0	346	353	428	542
1957	403	734	2,726	9,688	62,084	37,691	394	73,042	8,033	13,252	2,694	1,235
1958	3,440	3,464	8,955	6,933	13,739	18,761	192,442	61,003	65,991	1,269	1,059	1,698
1959	1,486	1,511	278	569	8,630	14,684	23,163	36,874	3,271	2,758	417	25,107
1960	11,975	10,496	4,921	659	259	67,299	209,013	60,383	22,805	53,450	2,134	6,042
1961	2,195	7,256	24,753	7,495	2,583	9,082	19,625	12,069	24,017	1,343	11,787	6,539
1962	4,527	922	347	1,862	0	9,252	9,924	32,697	3,692	1,250	964	2,274
1963	1,149	2,236	1,176	516	4,852	28,776	11,138	16,598	12,989	390	338	544
1964	892	4,699	817	173	1,302	3,016	267	2,317	22,305	438	1,770	1,629
1965	1,867	972	1,658	256	23,774	214,674	14,922	25,867	2,111	24,402	9,511	2,743
1966	995	3,761	2,305	523	612	11,133	9,290	22,054	7,365	586	367	627
1967	1,819	1,498	743	15,529	5,733	29,190	74,493	15,574	9,965	13,078	3,521	5,534
1968	6,001	3,433	1,730	423	13,889	13,058	15,190	16,694	1,088	10,682	671	722
1969	1,790	4,339	5,103	547	41,932	48,425	28,316	23,966	70,578	16,953	5,075	3,854
1970	3,927	1,648	2,735	31,264	2,250	1,053	3,849	14,773	12,194	3,963	1,907	1,262
1971	1,854	2,599	1,256	1,671	9,758	22,066	32,380	30,998	19,515	8,212	34,425	11,031
1972	7,970	3,630	1,156	582	6,235	9,152	68,159	45,470	34,116	15,921	3,096	2,037
1973	2,785	2,922	15,432	18,573	2,173	94	14,217	9,889	567	369	0	787
1974	1,989	1,375	10,499	530	7,602	4,441	2,321	51,453	19,241	37,486	3,619	2,232
1975	4,727	4,970	2,590	3,566	3,737	32,958	19,807	10,854	875	537	496	590
1976	1,074	1,016	1,606	3,117	7,779	3,304	3,606	13,599	54,603	3,228	1,123	1,106

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	0	2,145	456	10,830	22,908	9,082	4,466	42,230	23,410	22	263	319
1978	386	1,567	1,116	499	28,944	52,901	1,401	2,697	18,805	7,702	1,546	778
1979	2,071	1,322	3,095	759	6,908	22,282	590	11,988	101	0	1,251	1,224
1980	3,417	7,020	3,414	2,678	20,986	7,149	0	5,834	2,128	0	0	1,062
1981	641	382	1,525	11	1,008	21,510	14,233	145,891	39,960	8,409	3,538	2,485
1982	2,068	2,244	2,219	1,366	6,804	37,543	44,454	9,224	6,229	6,999	2,354	6,332
1983	4,483	8,026	7,968	3,193	3,087	11,261	0	0	0	97	0	15
1984	1,191	1,164	1,459	4,139	1,765	4,343	1,125	14,184	100	6,858	2,925	4,637
1985	2,989	3,321	7,246	3,784	9,094	4,163	0	1,559	22,538	18,506	2,973	2,298
1986	2,161	4,820	2,056	258	1,228	11,776	956	15,909	26,643	7,081	12,313	2,836
1987	3,305	3,617	6,150	878	66,907	21,626	1,065	21,380	13,084	2,244	1,343	2,890
1988	6,041	2,467	12,192	11,672	31,290	35,556	38,250	5,437	40,068	3,181	531	3,495
1989	2,649	2,822	1,978	1,098	20,012	28,573	8,232	21,591	12,705	1,730	6,862	2,215
1990	4,162	6,821	5,400	4,147	2,713	302	1,185	1,955	22,991	4,653	4,668	1,686
1991	4,973	1,754	854	1,192	14,214	14,911	24,555	37,393	159	1,869	2,794	7,026
1992	9,862	3,305	1,982	2,922	5,497	51,380	13,082	16,156	4,138	286	890	3,844
1993	3,113	3,972	3,621	2,339	3,526	20,261	11,290	9,297	15,468	2,679	1,384	1,297
1994	1,136	1,114	2,731	1,149	15,775	11,253	17,884	1,300	3,640	37,023	1,325	2,025
1995	2,394	1,003	2,011	2,077	9,138	15,836	13,860	23,042	19,561	9,040	3,372	2,002
1996	1,943	1,281	777	427	3,418	19,771	50,038	36,855	18,353	5,508	3,880	4,309
1997	2,983	3,066	2,065	23,147	10,534	23,073	4,912	20,814	1,432	4,487	2,564	4,146
1998	6,395	4,592	11,062	3,319	2,407	76	0	6,092	320	17,649	14,311	2,714
1999	2,708	5,949	5,499	12,618	90,013	35,063	8,067	49,066	13,182	753	333	2,242
2000	1,661	2,642	19,474	11,470	2,804	6,982	3,214	0	0	13,994	4,557	1,641
2001	5,228	6,632	10,983	4,130	5,217	1,730	496	0	0	0	592	0
2002	1,476	1,948	596	4,054	2,816	4,145	1,155	6,053	9,771	0	2,051	3,020
2003	2,545	2,525	2,130	1,472	947	15,899	1,573	81	10,010	1,056	214	547
2004	1,024	1,752	4,328	6,370	1,741	9,548	9,783	11,633	2,592	8,898	10,778	6,528
2005	7,636	6,556	5,603	4,623	4,346	19,661	1,404	2,828	3,543	0	293	0
2006	1,491	1,463	4,528	0	365	351	3,299	6,228	6,567	2,088	929	2,613
2007	3,590	4,122	7,448	8,044	4,392	4,391	2,617	1,527	0	0	1,144	442
2008	715	1,123	1,033	1,163	1,323	1,116	8,758	23,767	2,391	15,683	3,384	1,660
2009	1,622	1,787	2,264	2,810	1,788	1,296	1,163	6,215	1,104	173	1,458	341
2010	752	5,241	4,258	4,933	2,605	1,592	909	192	0	826	708	1,302
2011	447	937	900	555	565	756	1,207	242	124	5	122	440
2012	78	240	526									

Table C-3: Extended Net Evaporation at Lake Meredith

-Values in Feet-

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	0.009	0.185	0.426	0.398	0.394	0.580	0.902	0.588	0.610	0.550	0.053	0.181
1941	0.109	0.107	0.128	0.317	-0.077	0.153	0.231	0.395	0.270	-0.206	0.231	0.175
1942	0.147	0.181	0.299	0.096	0.501	0.258	0.651	0.382	0.345	-0.076	0.397	0.129
1943	0.180	0.256	0.336	0.382	0.475	0.595	0.428	0.700	0.561	0.489	0.257	0.004
1944	0.017	0.107	0.352	0.233	0.314	0.547	0.393	0.545	0.439	0.291	0.194	-0.009
1945	0.046	0.168	0.334	0.270	0.642	0.627	0.516	0.416	0.402	0.287	0.350	0.196
1946	0.191	0.204	0.353	0.446	0.483	0.619	0.740	0.396	0.236	-0.011	0.064	0.172
1947	0.207	0.251	0.264	0.276	0.133	0.529	0.640	0.605	0.724	0.425	0.200	0.064
1948	0.091	-0.033	0.215	0.505	0.337	0.433	0.532	0.313	0.621	0.367	0.140	0.349
1949	0.076	0.134	0.311	0.251	0.106	0.292	0.315	0.443	0.379	0.324	0.332	0.144
1950	0.257	0.190	0.399	0.384	0.493	0.344	-0.089	0.303	0.113	0.445	0.316	0.257
1951	0.100	0.158	0.325	0.438	-0.108	0.352	0.779	0.887	0.837	0.614	0.310	0.226
1952	0.238	0.287	0.333	0.270	0.468	0.800	0.786	0.856	0.875	0.808	0.364	0.211
1953	0.267	0.253	0.507	0.598	0.728	0.903	0.748	0.594	0.954	0.346	0.287	0.062
1954	0.123	0.344	0.398	0.381	0.064	0.637	0.680	0.517	0.712	0.330	0.339	0.261
1955	0.135	0.216	0.415	0.532	0.061	0.457	0.642	0.513	0.333	0.450	0.345	0.236
1956	0.161	0.059	0.487	0.566	0.534	0.648	0.524	0.635	0.727	0.484	0.311	0.244
1957	0.145	0.146	-0.012	0.089	-0.021	0.476	0.763	0.281	0.423	0.085	0.080	0.251
1958	0.026	0.074	-0.087	0.169	0.130	0.491	0.113	0.502	0.334	0.363	0.183	0.120
1959	0.140	0.184	0.361	0.369	0.088	0.466	0.327	0.335	0.519	0.137	0.202	-0.172
1960	-0.009	0.034	0.185	0.426	0.390	0.126	0.091	0.363	0.048	-0.064	0.253	0.109
1961	0.072	0.056	0.038	0.404	0.391	0.252	0.276	0.347	0.378	0.355	-0.025	0.150
1962	0.018	0.197	0.328	0.329	0.547	0.086	0.185	0.433	0.224	0.366	0.214	0.109
1963	0.058	0.150	0.469	0.643	0.358	0.407	0.636	0.376	0.363	0.464	0.300	0.060
1964	0.060	-0.007	0.304	0.574	0.475	0.582	0.794	0.596	0.312	0.451	0.095	0.089
1965	0.090	0.129	0.067	0.398	0.319	0.033	0.560	0.563	0.582	0.448	0.336	0.101
1966	0.040	0.067	0.461	0.581	0.817	0.449	0.836	0.275	0.352	0.415	0.346	0.163
1967	0.293	0.273	0.541	0.419	0.685	0.420	0.304	0.459	0.475	0.576	0.202	0.134
1968	0.069	0.123	0.274	0.559	0.427	0.317	0.462	0.425	0.609	0.382	0.176	0.114
1969	0.237	0.101	0.138	0.507	0.284	0.357	0.583	0.531	0.202	0.182	0.184	0.145
1970	0.131	0.283	0.217	0.482	0.898	0.871	0.875	0.644	0.616	0.340	0.315	0.227
1971	0.176	0.191	0.514	0.613	0.778	0.775	0.682	0.468	0.251	0.271	0.110	0.127
1972	0.249	0.271	0.584	0.752	0.463	0.461	0.399	0.569	0.532	0.290	-0.019	0.039
1973	0.086	0.149	-0.036	0.253	0.569	0.817	0.556	0.764	0.292	0.405	0.274	0.147
1974	0.089	0.314	0.298	0.697	0.632	0.731	0.893	0.057	0.343	-0.004	0.227	0.075
1975	0.131	0.004	0.345	0.448	0.523	0.428	0.245	0.676	0.379	0.530	0.155	0.165
1976	0.241	0.390	0.391	0.403	0.529	0.775	0.634	0.488	-0.183	0.311	0.153	0.169

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	0.197	0.270	0.553	0.335	0.088	0.732	0.832	0.106	0.491	0.422	0.295	0.255
1978	0.127	0.147	0.388	0.636	0.223	0.540	0.921	0.633	0.352	0.411	0.112	0.162
1979	0.178	0.218	0.297	0.414	0.180	0.320	0.700	0.419	0.448	0.388	0.217	0.268
1980	0.041	0.156	0.202	0.442	0.207	0.608	0.975	0.812	0.532	0.494	0.177	0.116
1981	0.131	0.305	0.227	0.520	0.357	0.552	0.684	0.252	0.218	0.155	0.093	0.164
1982	0.297	0.247	0.414	0.572	0.281	0.093	0.101	0.619	0.425	0.413	0.242	0.061
1983	0.040	-0.039	0.170	0.406	0.398	0.497	0.834	0.743	0.688	0.204	0.204	0.072
1984	0.092	0.251	0.241	0.459	0.741	0.611	0.825	0.248	0.536	0.098	0.166	0.037
1985	0.057	0.130	0.185	0.269	0.565	0.504	0.774	0.540	0.282	0.109	0.099	0.091
1986	0.228	0.165	0.443	0.589	0.473	0.158	0.710	0.504	0.272	0.116	0.042	0.051
1987	0.104	0.165	0.156	0.496	0.194	0.328	0.626	0.473	0.179	0.310	0.179	0.090
1988	0.140	0.233	0.336	0.296	0.383	0.480	0.386	0.430	0.083	0.408	0.316	0.206
1989	0.197	0.265	0.468	0.583	0.336	0.240	0.692	0.483	0.415	0.445	0.341	0.022
1990	0.076	0.174	0.272	0.477	0.626	1.016	0.627	0.517	0.220	0.388	0.239	0.119
1991	0.046	0.325	0.490	0.597	0.424	0.385	0.235	0.419	0.354	0.430	0.066	-0.100
1992	0.088	0.218	0.417	0.258	0.361	0.108	0.606	0.073	0.542	0.474	0.134	0.040
1993	-0.016	0.106	0.311	0.421	0.487	0.460	0.478	0.628	0.568	0.405	0.220	0.207
1994	0.303	0.160	0.366	0.455	0.367	0.655	0.593	0.511	0.524	0.206	-0.208	0.156
1995	0.108	0.259	0.410	0.400	0.097	0.340	0.572	0.716	0.256	0.425	0.308	0.101
1996	0.118	0.349	0.416	0.720	0.810	0.580	0.107	0.222	0.102	0.360	0.140	0.199
1997	0.140	0.085	0.468	-0.170	0.327	0.428	0.623	0.219	0.385	0.362	0.114	0.011
1998	0.124	0.069	0.220	0.484	0.589	0.967	0.586	0.469	0.561	0.039	0.173	0.157
1999	0.077	0.360	0.178	0.221	0.111	0.544	0.567	0.528	0.447	0.363	0.301	0.160
2000	0.230	0.332	0.076	0.442	0.665	0.258	0.734	0.940	0.799	-0.051	0.120	0.067
2001	0.059	0.048	0.081	0.626	0.336	0.693	0.929	0.558	0.492	0.461	0.167	0.200
2002	0.130	0.218	0.472	0.467	0.681	0.599	0.480	0.454	0.481	-0.135	0.241	0.134
2003	0.201	0.171	0.317	0.761	0.718	0.014	0.958	0.744	0.447	0.405	0.284	0.263
2004	0.208	0.144	0.334	0.407	0.865	0.108	0.583	0.507	0.190	0.303	-0.094	0.172
2005	-0.076	0.181	0.335	0.546	0.420	0.183	0.789	0.380	0.714	0.259	0.388	0.191
2006	0.308	0.317	0.288	0.688	0.603	0.845	0.719	0.102	0.345	0.164	0.270	-0.022
2007	0.054	0.395	-0.142	0.270	0.357	0.492	0.573	0.593	0.186	0.494	0.288	0.039
2008	0.270	0.234	0.415	0.590	0.628	0.835	0.289	0.347	0.416	-0.078	0.265	0.213
2009	0.234	0.286	0.414	0.313	0.485	0.666	0.565	0.465	0.366	0.175	0.292	0.110
2010	0.062	-0.056	0.211	0.369	0.495	0.642	0.411	0.334	0.525	0.382	0.114	0.121
2011	0.105	0.178	0.426	0.721	0.912	1.118	1.118	0.665	0.595	0.404	0.265	-0.003
2012	0.250	0.121	0.416									

Table C-4: 2010 and 2070 Elevation Area Capacity Relationship for Lake Meredith

2010 Conditions			2070 Conditions		
Elevation (ft)	Area (Ac)	Capacity (Ac-Ft)	Elevation (ft)	Area (Ac)	Capacity (Ac-Ft)
2820	0	0	2820	0	0
2825	398	787	2825	171	144
2830	833	3,861	2830	606	2,083
2835	1,265	9,163	2835	1,038	6,251
2840	1,570	16,239	2840	1,343	12,194
2845	1,954	25,023	2845	1,727	19,845
2850	2,657	36,433	2850	2,430	30,122
2855	3,449	51,663	2855	3,222	44,218
2860	4,181	70,796	2860	3,954	62,219
2865	4,809	93,279	2865	4,582	83,568
2870	5,364	118,762	2870	5,137	107,918
2875	5,815	146,721	2875	5,588	134,743
2880	6,281	176,894	2880	6,054	163,783
2885	6,801	209,619	2885	6,574	195,376
2890	8,241	245,468	2890	8,014	230,092
2895	8,939	288,846	2895	8,712	272,336
2900	10,420	335,304	2900	10,193	317,661
2905	11,045	388,780	2905	10,818	370,004
2910	11,730	445,578	2910	11,503	425,668
2915	12,359	505,474	2915	12,132	484,432
2920	13,510	568,927	2920	13,283	546,751
2925	14,220	637,881	2925	13,993	614,572
2926	14,352	652,167	2926	14,125	628,632
2927	14,495	666,591	2927	14,268	642,829
2928	14,650	681,163	2928	14,423	657,174
2929	14,815	695,896	2929	14,588	671,680
2930	15,024	710,815	2930	14,797	686,373
2931	15,153	725,904	2931	14,926	701,235
2932	15,288	741,124	2932	15,061	716,229
2933	15,430	756,483	2933	15,203	731,362
2934	15,579	771,988	2934	15,352	746,639
2935	15,793	787,674	2935	15,566	762,099
2936	16,018	803,579	2936	15,791	777,778
2936.5	16,345	811,670	2936.5	16,118	785,755

1.3 Lake Meredith Yield Results

Model analyses were executed for a repeat of the historical hydrology from January 1940 through March 2012. The model assumes that the reservoir starts full to the top of the usable volume, with a certain diversion target repeated for each year of simulation. This target is then adjusted until the model converges on the reservoir yield. This iteration process was used to determine both the firm yield (volume that can be diverted every year without shortage) and the safe yield (volume that can be diverted every year with one year reserve capacity) for Lake Meredith. Because supplies must be assessed through year 2070, several model runs were performed for estimated sedimentation conditions for years 2010, 2020, 2040, and 2070 to account for any loss of storage capacity over time. Yields for intermediate decades were interpolated from the adjacent models. Results of the Operate model runs for firm and safe yield are shown in Figure C-1 and Table C-5 below.

Figure C-1: Model Reservoir Storage Trace

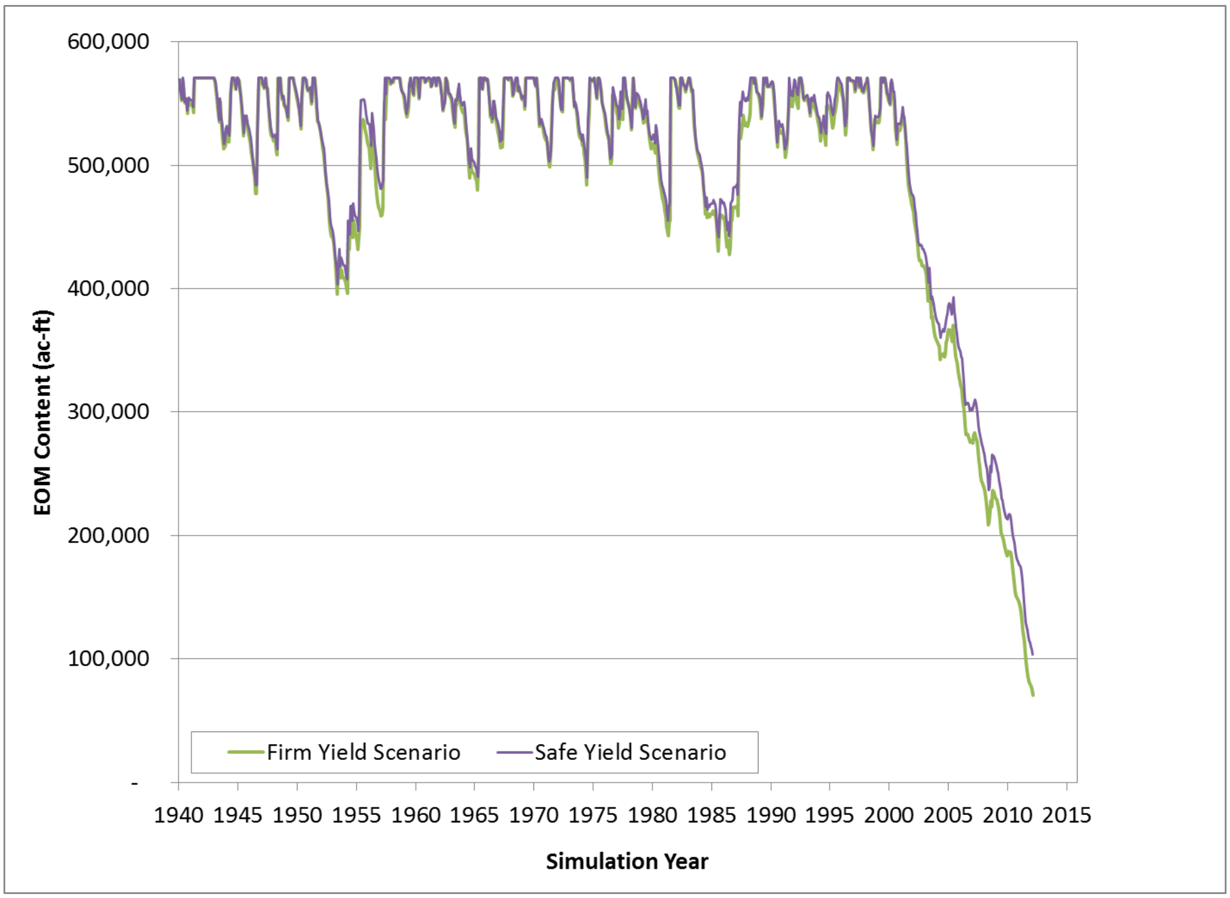


Table C-5: Modeled Lake Meredith Yield

Scenario	Yield (acre-feet per year)						
	2010	2020	2030	2040	2050	2060	2070
Firm Yield	37,505	37,584	37,662	37,739	37,811	37,835	37,956
Safe Yield	32,928	32,974	33,024	33,073	33,128	33,146	33,238

The modeled reservoir storage illustrated in Figure C-1 shows several periods of prolonged decreased reservoir capacity. The first of these corresponds with the drought of the 1950s which is the drought of record for much of the state, with subsequent level drops in the early to mid-1980s. The trend of declining inflows and severity of the ongoing drought are clearly shown as storage declines drastically after the late 1990s, with the minimum reservoir content reached at the end of the simulation.

As shown in Table C-5, the model showed a slight increase in yield over time. This minor variation is due to several factors, including the low yield of the reservoir, minor rounding impacts from area-capacity-elevation curves, and the ability of the 500,000 acre-feet usable capacity to adjust in elevation over time due to sedimentation. As these gains are minor and driven partially by the limitations of the available data, it is recommended that the year 2010 values of firm and safe yield as reflected in Table C-6 be applied for all decades of the planning cycle. The reliable supply shown in Table C-6 was determined in conjunction with CRMWA, and reflects diversions in recent years from Lake Meredith.

Table C-6. Recommended Lake Meredith Yield

Lake Meredith	Supply (acre-feet per year)	
	2011 Water Plan	**2016 Water Plan**
Permitted Diversion	151,200	151,200
Firm Yield	69,750	37,505
Safe Yield	63,750	32,928
Reliable Supply	50,000	0[1]

1. Determined in conjunction with CRMWA, dependent on the CRMWA supply allocation process.

Table C-6 shows a significant decrease in reservoir yield and reliable supply from previous estimates. This is consistent with current observations and operations.

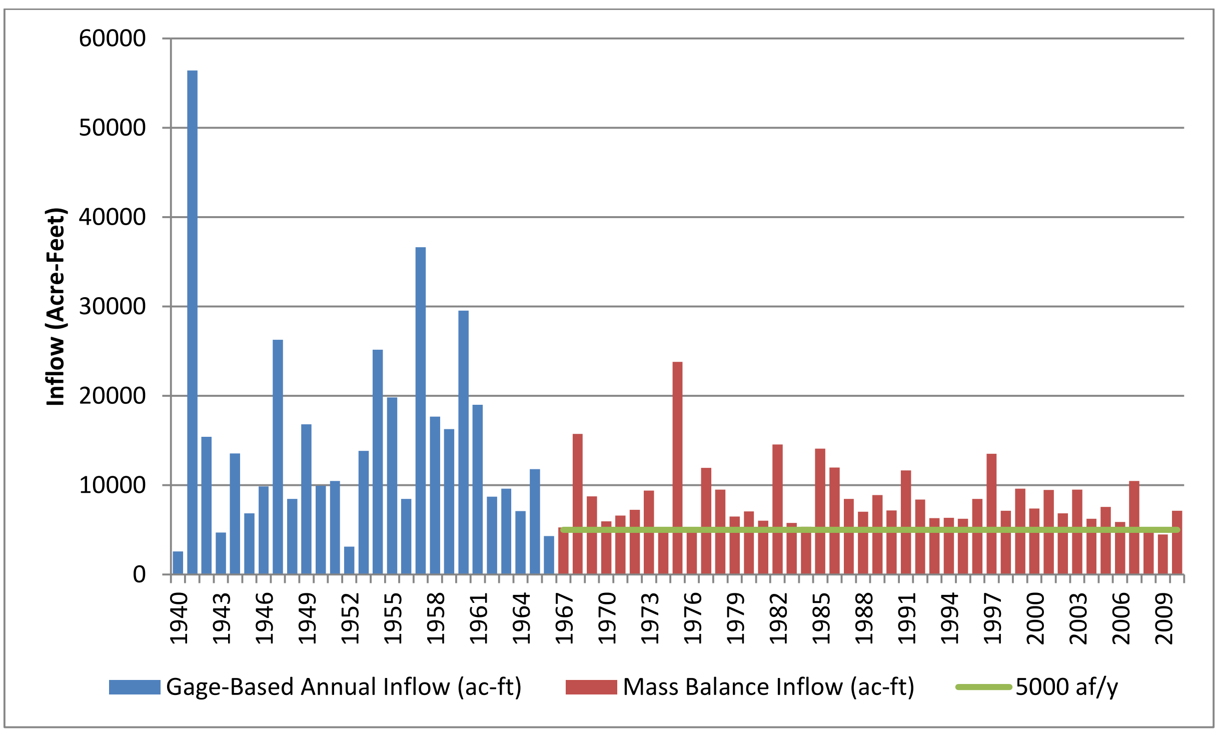
2.1 Greenbelt Reservoir

In the Red River Basin, the Greenbelt Municipal and Industrial Water Authority completed a water supply study for Greenbelt Reservoir[1]. This study used reservoir-specific data through June 2011 to calculate inflows and reservoir yield. By extending the hydrology it was possible to develop a more accurate supply availability due to the impacts of the ongoing drought. The findings of this study were the basis for the yield of Greenbelt Reservoir in the 2016 Panhandle Water Plan.

2.2 Hydrology for Greenbelt Reservoir

New hydrology was developed for the historical period of the reservoir (9/1967 to 6/2011). This hydrology is based on a mass-balance analysis of the reservoir, using the most recent evaporation and precipitation from the Texas Water Development Board and updated area-capacity data. Hydrology prior to the historical period is from previous studies. The pre-reservoir hydrology is based on data from two gages. The June 1960 to September1964 flows are from the Salt Fork Red River near Clarendon gage (USGS 07299850), which was located at the current dam site. Flows prior to June 1960 and from October 1964 to August 1967 are based on the Wellington gage. As shown in Figure C-2, the flows based on the Wellington gage have much more year-to-year variation than the mass balance and Clarendon gage flows. The extended inflows are shown in Table C-7 and the extended net evaporation is shown in Table C-8.

Figure C-2 Historical Inflows to Greenbelt Reservoir



[1] Freese and Nichols Inc. *Assessment of Potential Water Supplies,* prepared for the Greenbelt Municipal and Industrial Water Authority. December 2011.

Table C-7: Extended Inflow to Greenbelt Reservoir

-Values in Acre-Feet-

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	0	400	0	420	200	20	420	360	260	0	390	100
1941	170	580	510	4,650	13,480	22,880	2,290	1,910	1,160	6,700	1,000	1,090
1942	910	530	940	3,880	660	750	140	130	310	5,170	510	1,470
1943	970	350	270	660	1,560	460	30	0	0	0	0	400
1944	1,510	570	1,400	280	240	5,410	1,800	220	230	330	350	1,230
1945	1,030	580	1,310	1,010	140	1,480	1,230	80	0	0	0	0
1946	660	550	290	920	480	160	90	200	790	4,640	550	530
1947	720	180	620	1,530	17,060	5,060	850	10	0	140	40	80
1948	100	1,070	1,670	50	1,300	4,050	70	20	0	0	40	80
1949	580	2,620	700	490	8,870	1,890	110	130	540	290	170	440
1950	620	640	210	240	270	900	2,610	1,200	2,320	220	170	530
1951	590	400	350	330	5,050	1,330	1,770	0	20	260	160	210
1952	480	330	340	1,020	230	0	40	20	40	80	350	210
1953	170	270	370	510	160	30	9,190	940	110	1,380	320	400
1954	470	240	150	720	10,340	11,840	130	870	80	100	110	120
1955	270	300	100	80	6,050	9,730	620	160	70	1,950	130	360
1956	370	350	110	80	6,610	90	220	20	30	480	40	60
1957	100	220	780	7,610	22,510	1,260	80	2,390	270	520	690	210
1958	690	450	970	660	6,800	1,720	4,970	70	610	110	180	450
1959	570	340	110	310	5,220	910	4,330	50	840	1,630	380	1,580
1960	1,870	1,350	1,800	140	1,450	10,290	1,210	1,450	740	7,310	660	1,270
1961	730	1,140	1,280	830	540	6,290	2,860	670	390	1,960	1,640	670
1962	540	740	690	790	750	1,930	450	940	290	350	640	610
1963	300	1,300	700	300	200	500	0	3,200	1,300	500	600	700
1964	1,000	1,100	700	300	400	1,300	100	0	700	200	700	600
1965	500	400	300	300	200	7,800	200	100	300	800	300	600
1966	600	700	200	300	200	200	200	800	400	200	200	300
1967	200	200	200	700	200	200	300	100	1,000	1,414	361	407
1968	707	388	855	712	1,155	4,139	165	6,540	365	229	235	264
1969	635	518	690	525	2,469	1,304	124	782	560	504	113	533
1970	539	393	402	3,155	343	203	97	188	58	29	227	325
1971	516	484	535	357	205	245	0	754	647	1,069	1,302	474
1972	316	515	493	321	1,482	1,542	1,331	167	21	41	455	570
1973	568	574	1,265	2,384	499	1,127	335	0	1,802	317	229	279
1974	807	653	568	482	269	383	120	589	117	478	286	432
1975	362	486	409	491	12,415	9,284	0	0	0	0	0	356
1976	296	644	378	699	591	0	35	340	1,303	38	246	476

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	460	817	350	1,317	6,489	452	471	476	176	159	262	495
1978	423	796	532	504	4,309	1,271	170	0	387	252	431	418
1979	637	345	971	563	608	901	366	272	615	470	293	444
1980	398	638	678	1,044	723	610	256	2,712	0	0	0	0
1981	0	0	352	627	537	1,381	139	780	562	594	566	472
1982	383	497	716	593	2,267	4,502	3,997	370	105	213	435	472
1983	740	821	816	620	331	1,201	193	0	287	291	225	264
1984	769	655	700	694	233	1,180	164	0	0	0	262	699
1985	388	1,223	1,134	1,252	538	1,282	485	627	821	5,555	368	422
1986	679	788	909	476	891	748	244	745	1,176	2,781	1,762	789
1987	840	883	993	889	1,648	441	270	520	548	344	345	750
1988	792	642	903	810	733	907	250	117	545	350	392	573
1989	609	535	944	578	659	3,006	5	763	506	355	505	418
1990	629	680	616	2,061	1,349	384	0	269	359	264	305	276
1991	650	592	615	723	1,366	1,210	2,127	969	1,177	492	834	904
1992	663	778	1,080	816	557	2,042	543	122	192	378	464	748
1993	803	680	825	799	773	386	84	423	193	270	568	495
1994	669	606	859	947	908	353	363	783	0	0	427	440
1995	333	340	645	582	552	1,673	311	271	88	317	588	549
1996	563	664	491	1,047	0	583	992	1,449	851	503	622	692
1997	685	801	799	6,931	1,221	729	267	220	213	445	540	649
1998	810	777	1,560	757	704	276	225	101	110	650	712	450
1999	0	1,161	1,192	1,209	2,642	1,288	1,042	0	0	0	407	664
2000	571	612	0	1,639	392	2,313	259	106	53	475	414	556
2001	794	857	735	438	2,841	315	160	694	415	55	1,841	330
2002	538	420	303	968	442	506	407	334	501	1,383	434	619
2003	625	427	703	629	338	1,759	540	354	2,750	354	474	555
2004	680	753	1,126	963	289	373	293	20	111	447	562	632
2005	731	614	884	894	567	2,778	0	0	0	140	412	559
2006	619	480	661	355	412	487	266	782	379	224	393	832
2007	824	567	2,660	1,002	2,604	672	275	141	59	322	664	694
2008	521	558	677	679	128	285	68	754	0	491	407	505
2009	471	494	679	560	398	339	42	181	182	384	411	352
2010	448	632	609	1,335	909	359	1,365	0	237	351	436	448
2011	386	439	299	0	0	0						

Table C-8: Extended Net Evaporation at Greenbelt Reservoir

-Values in Feet-

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1940	0.07	0.14	0.47	0.31	0.42	0.60	0.96	0.57	0.63	0.51	0.05	0.18
1941	0.10	0.05	0.11	0.19	-0.12	0.02	0.42	0.40	0.35	-0.26	0.23	0.14
1942	0.17	0.21	0.31	0.02	0.48	0.35	0.67	0.39	0.32	-0.04	0.37	0.04
1943	0.21	0.30	0.33	0.35	0.23	0.58	0.53	0.94	0.59	0.48	0.28	-0.03
1944	-0.02	0.10	0.33	0.36	0.34	0.50	0.47	0.60	0.36	0.29	0.22	-0.03
1945	0.06	0.14	0.28	0.19	0.62	0.61	0.52	0.52	0.44	0.27	0.34	0.20
1946	0.12	0.18	0.32	0.46	0.46	0.52	0.80	0.56	0.18	0.04	0.14	0.15
1947	0.18	0.27	0.25	0.18	-0.04	0.57	0.76	0.79	0.81	0.48	0.17	0.12
1948	0.12	-0.02	0.21	0.50	0.37	0.45	0.56	0.42	0.65	0.40	0.29	0.36
1949	-0.09	0.12	0.26	0.20	0.03	0.32	0.52	0.49	0.37	0.28	0.36	0.17
1950	0.24	0.20	0.42	0.38	0.35	0.35	-0.05	0.34	0.05	0.50	0.38	0.24
1951	0.18	0.13	0.34	0.39	0.01	0.38	0.79	0.86	0.66	0.50	0.26	0.28
1952	0.23	0.28	0.35	0.20	0.49	0.87	0.79	0.99	0.83	0.78	0.33	0.17
1953	0.28	0.28	0.41	0.48	0.64	0.91	0.71	0.63	0.94	0.15	0.25	0.14
1954	0.14	0.34	0.38	0.29	-0.13	0.56	0.69	0.48	0.65	0.40	0.34	0.25
1955	0.11	0.19	0.41	0.58	-0.06	0.22	0.57	0.55	0.35	0.29	0.35	0.22
1956	0.17	0.08	0.50	0.57	0.30	0.64	0.60	0.73	0.71	0.45	0.31	0.22
1957	0.15	0.11	0.07	-0.02	-0.16	0.30	0.79	0.41	0.43	0.01	0.05	0.25
1958	0.03	0.09	-0.08	0.13	0.08	0.43	0.22	0.51	0.22	0.34	0.20	0.14
1959	0.16	0.19	0.40	0.33	0.03	0.27	0.28	0.48	0.48	0.08	0.23	-0.22
1960	-0.01	0.01	0.18	0.36	0.29	0.09	0.03	0.32	0.14	-0.21	0.27	0.05
1961	0.07	0.04	0.06	0.42	0.33	0.09	0.17	0.39	0.34	0.33	-0.01	0.13
1962	0.04	0.25	0.38	0.27	0.52	0.04	0.26	0.53	0.09	0.28	0.17	0.12
1963	0.06	0.18	0.46	0.55	0.32	0.28	0.66	0.36	0.32	0.46	0.25	0.06
1964	0.11	0.00	0.36	0.60	0.44	0.48	0.83	0.60	0.22	0.38	0.06	0.07
1965	0.10	0.13	0.13	0.39	0.32	-0.09	0.69	0.46	0.23	0.23	0.30	0.17
1966	0.03	-0.01	0.45	0.29	0.48	0.42	0.70	0.14	0.21	0.46	0.42	0.13
1967	0.09	0.14	0.44	0.37	0.34	0.29	0.34	0.50	0.32	0.51	0.22	0.09
1968	-0.10	-0.02	0.20	0.35	0.05	0.38	0.38	0.28	0.49	0.38	0.12	0.04
1969	0.06	0.04	0.05	0.42	0.10	0.40	0.62	0.42	0.12	0.09	0.19	0.02
1970	0.09	0.16	0.06	0.28	0.52	0.60	0.60	0.54	0.43	0.25	0.18	0.17
1971	0.24	0.14	0.34	0.45	0.43	0.46	0.55	0.30	0.06	0.17	0.11	0.04
1972	0.16	0.26	0.50	0.50	0.08	0.35	0.40	0.41	0.31	0.15	-0.01	0.19
1973	0.06	0.09	-0.17	-0.03	0.30	0.47	0.38	0.57	0.11	0.32	0.26	0.26
1974	0.19	0.36	0.26	0.54	0.34	0.58	0.87	0.19	0.03	0.04	0.17	0.10
1975	0.05	-0.01	0.18	0.34	0.11	0.35	0.17	0.46	0.27	0.51	0.06	0.16
1976	0.25	0.37	0.38	0.20	0.30	0.51	0.46	0.61	0.17	0.26	0.22	0.24

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	0.10	0.20	0.46	0.14	-0.07	0.52	0.76	0.25	0.57	0.39	0.30	0.29
1978	0.06	0.05	0.38	0.59	-0.05	0.36	0.77	0.61	0.23	0.40	0.08	0.21
1979	0.04	0.08	0.10	0.29	0.16	0.20	0.39	0.34	0.47	0.46	0.19	0.20
1980	0.09	0.18	0.34	0.40	0.07	0.65	0.99	0.73	0.38	0.47	0.19	0.15
1981	0.19	0.24	0.22	0.41	0.29	0.56	0.52	0.32	0.35	0.07	0.22	0.22
1982	0.19	0.16	0.40	0.48	0.04	0.09	0.36	0.60	0.53	0.45	0.22	0.05
1983	0.05	0.01	0.21	0.34	0.28	0.36	0.88	0.75	0.60	0.05	0.24	0.07
1984	0.15	0.33	0.22	0.48	0.56	0.40	0.64	0.39	0.58	0.25	0.19	-0.01
1985	0.07	0.09	0.15	0.36	0.40	0.17	0.60	0.52	0.22	0.00	0.15	0.00
1986	0.31	0.22	0.51	0.44	0.26	0.25	0.82	0.21	0.17	-0.10	0.04	0.08
1987	0.10	0.04	0.22	0.51	0.00	0.31	0.63	0.39	0.19	0.37	0.23	0.00
1988	0.09	0.21	0.19	0.27	0.37	0.43	0.40	0.52	0.13	0.37	0.31	0.26
1989	0.20	0.08	0.37	0.47	0.09	-0.03	0.58	0.27	0.27	0.49	0.48	0.17
1990	0.11	0.05	0.11	0.15	0.24	0.71	0.55	0.51	0.33	0.33	0.12	0.13
1991	0.09	0.28	0.47	0.60	0.34	0.45	0.61	0.60	0.25	0.57	0.17	0.06
1992	0.08	0.24	0.34	0.27	0.14	0.03	0.58	0.40	0.57	0.49	0.12	0.14
1993	0.07	0.15	0.29	0.47	0.40	0.56	0.69	0.65	0.65	0.48	0.32	0.25
1994	0.25	0.21	0.34	0.38	0.37	0.84	0.68	0.76	0.57	0.43	0.32	0.20
1995	0.00	0.00	0.37	0.36	0.02	0.25	0.49	0.34	0.05	0.50	0.40	0.30
1996	0.27	0.40	0.48	0.68	0.44	0.40	0.24	0.25	0.09	0.39	0.26	0.37
1997	0.22	0.09	0.56	-0.25	0.15	0.31	0.60	0.29	0.33	0.29	0.24	-0.03
1998	0.22	0.04	0.22	0.48	0.48	0.91	0.77	0.48	0.61	0.11	0.10	0.14
1999	0.17	0.29	0.15	0.29	0.15	0.38	0.64	0.52	0.32	0.46	0.44	0.33
2000	0.26	0.33	0.12	0.37	0.54	0.02	0.67	0.81	0.78	0.06	0.26	0.15
2001	0.05	0.09	0.05	0.35	0.09	0.76	0.93	0.48	0.45	0.53	0.04	0.00
2002	0.15	0.02	0.11	0.37	0.51	0.58	0.48	0.58	0.43	-0.17	0.17	-0.07
2003	0.19	0.13	0.37	0.52	0.50	0.06	0.90	0.65	0.37	0.40	0.35	0.34
2004	0.17	0.21	0.25	0.16	0.62	0.13	0.49	0.39	0.38	0.06	-0.17	0.28
2005	0.08	0.12	0.29	0.38	0.20	0.48	0.59	0.26	0.55	0.30	0.47	0.39
2006	0.48	0.38	0.36	0.51	0.41	0.72	0.68	0.28	0.27	0.26	0.36	-0.02
2007	0.17	0.33	-0.05	0.26	0.04	0.21	0.49	0.49	0.27	0.60	0.69	0.20
2008	0.21	0.29	0.49	0.56	0.31	0.50	0.54	0.30	0.18	0.07	0.42	0.37
2009	0.31	0.34	0.45	0.31	0.39	0.44	0.52	0.44	0.32	0.23	0.41	0.11
2010	0.06	0.08	0.27	0.13	0.28	0.55	0.22	0.54	0.47	0.39	0.41	0.33
2011	0.13	0.16	0.28	0.35	0.26	0.40						

Area-capacity information is based on the original curve for the reservoir, adjusted for sedimentation over time. (Since there has not been a volumetric survey conducted of the reservoir, the accuracy of the original area-capacity curve is uncertain.) The reservoir has never filled and storage has varied somewhat over time. As a result, instead of the common assumption of uniform distribution of sediment, it was assumed that the sediment distribution was based on the amount of time a particular elevation slice was inundated. New area-capacity curves were developed for 1976, 1986, 1996 and 2011. These curves were used in the mass balance analysis. The 2011 and 2070 curves were used in the yield modeling and are shown in Table C-9.

Table C-9: 2011 and 2070 Elevation Area Capacity Relationship for Greenbelt Reservoir

2011 Condition			2070 Condition		
Elevation (ft)	**Area (Ac)**	**Capacity (Ac-Ft)**	**Elevation (ft)**	**Area (Ac)**	**Capacity (Ac-Ft)**
2600	0	0	2600	0	0
2605	59	108	2605	0	0
2610	159	656	2610	0	0
2615	246	1,663	2615	0	0
2620	332	3,093	2620	0	0
2625	452	5,044	2625	89	160
2630	598	7,661	2630	235	957
2635	738	11,013	2635	390	2,522
2640	938	15,151	2640	671	5,072
2645	1,176	20,447	2645	1,018	9,331
2650	1,417	26,899	2650	1,369	15,224
2651	1,467	28,341	2651	1,432	16,625
2652	1,513	29,832	2652	1,496	18,088
2653	1,556	31,366	2653	1,543	19,608
2654	1,599	32,943	2654	1,594	21,177
2655	1,640	34,562	2655	1,638	22,793
2656	1,675	36,219	2656	1,675	24,449
2657	1,715	37,914	2657	1,715	26,144
2658	1,760	39,652	2658	1,760	27,882
2659	1,800	41,432	2659	1,800	29,662
2660	1,835	43,249	2660	1,835	31,479
2661	1,870	45,102	2661	1,870	33,332
2662	1,910	46,992	2662	1,910	35,222
2663	1,950	48,922	2663	1,950	37,152
2664	1,990	50,892	2664	1,990	39,122

2.3 Greenbelt Reservoir Yield Analyses

Computer simulations were performed to determine the reliable supply, or yield, of Greenbelt Reservoir. These computer runs used an Excel-based reservoir operation model. The model used historical hydrologic data (inflows, evaporation and precipitation) and relevant reservoir data (area-capacity relationships, storage, and diversions) to simulate the behavior of the reservoir during a repeat of historical hydrologic conditions. The hydrology used in the studies covers the period from January 1940 to June 2011. The currently available conservation storage volume in the reservoir was estimated to be 50,892 acre-feet (this volume is less than the permitted volume due to sediment accumulation over time).

These runs determined both the firm yield and safe yield of the reservoir. Firm yield is defined as the largest diversion from the reservoir that does not result in a shortage during the simulation period. The minimum storage in the reservoir for a firm yield run is close to zero. Safe yield is a more conservative estimate of the reliable supply from the reservoir. Safe yield assumes that a minimum volume equal to one year's diversion from the reservoir is maintained throughout the simulation period.

Because Greenbelt Reservoir is at historical lows, GMIWA was concerned about the reliability of supplies. Yield runs show what would happen in a repeat of historical hydrologic conditions. However, since these yield runs also reach their minimum storage in 2011 they are not necessarily a good predictor of what the future conditions might be in the reservoir.

In order to evaluate the potential near-term reliability of supplies, the reservoir operation model developed for the yield studies was modified to begin with current conditions and step through the historical hydrology in five year increments. This type of modeling is referred to as Conditional Reliability Modeling. The model began with the storage at the end of June 2011 (7,316 acre-feet) and first runs the hydrology from July 1940 to June 1945. The next step again starts with storage of 7,316 acre-feet and runs the hydrology from July 1941 to June 1946. These steps were repeated until the last five-year period of the available hydrology, July 2006 to June 2011, a total of 67 iterations. The model was run with the average recent demand of 3,850 acre-feet per year with and without downstream releases, as well as at the safe yield of the reservoir.

The CRM yield was used as the baseline 2020 condition with the safe yield representing the 2070 condition. The firm yields were determined as described in the paragraph above. Table C-10 below shows the results of the various analyses.

Table C-10: Greenbelt Reservoir Availability and Yield

Year	CRM and Safe Yield (Acre-Feet/ Year)	Firm Yield (Acre-Feet/ Year)
2020	3,850	5,362
2030	3,782	5,237
2040	3,714	5,112
2050	3,646	4,987
2060	3,578	4,862
2070	3,440	4,738

3.1 Palo Duro Reservoir

The Palo Duro Reservoir located in Hansford County is owned by the Palo Duro River Authority. Palo Duro Reservoir is not currently used as a water supply, but is included in the 2016 Panhandle Water Plan as an alternative strategy. For water supplies from the Palo Duro Reservoir, the yields from the 2011 Panhandle Water Plan were used since the hydrology from the Canadian WAM has not been extended and no new water rights have been granted in the Canadian Basin. The yield for 2070 was extrapolated from 2060 using a straight line interpolation of reservoir yields. The availability in 2020 is 3,917 acre-feet per year decreasing to 3,708 acre-feet per year in 2070.

4.1 Canadian River and Red River Run-of-River Diversions

The annual supply for the run-of-river water rights were determined using the TCEQ WAMs, Run 3. Run-of-river supplies are reported individually for municipal water rights and irrigation and/or industrial rights greater than 10,000 acre-feet /year. Smaller non-municipal water rights are aggregated by county. In the PWPA there are no individually reported run-of-river water rights. All run-of-river water rights are aggregated irrigation water rights. The reliable supply from these rights are estimated using the minimum annual diversion reported by the WAM analysis. This is considered a reasonable approach to reliable supplies for these water rights given the monthly time-step of the WAM and the uncertainty of the diversions. Some of these rights include storage and may also be supplemented with other sources of water, such as groundwater. There is no direct connection between the aggregated irrigation water demand by county and an individual irrigation water right. Therefore, evaluating water reliability as if such direct relationship existed is not practical. The following subsections discuss the run-of-river rights in the PWPA by river basin.

Canadian River Basin

The run-of-river flows for the Canadian River Basin were determined by using the TCEQ WAM Run 3 downloaded October 21, 2014. The flows were determined as the minimum annual diversion from the river. Table C-11 below shows the availability by county.

Table C-11: Canadian River Basin Run-of-River Availability

County	Use	Water Rights	Permitted Diversion (Acre-Feet/ Year)	Total Run-of-River (Acre-Feet/ Year)
Dallam	Irrigation	3791	190	0
Gray	Irrigation	3788	4	1
Hansford	Irrigation	3792, 3800, 3801, 3802, 3804, 4297	530	22
Hartley	Irrigation	3776	0	0
Hemphill	Irrigation	3789, 3790	0	0
Hutchinson	Irrigation	3783, 3786, 3799	356	98
Hutchinson	Industrial	3784, 3785	290[1]	0
Lipscomb	Irrigation	3805, 3807	122	66
Moore	Irrigation	3780, 3781, 3793, 3796, 3797, 3798	345	7
Ochiltree	Irrigation	3806	0	0
Oldham	Mining	3777	30	0

County	Use	Water Rights	Permitted Diversion (Acre-Feet/ Year)	Total Run-of-River (Acre-Feet/ Year)
Potter	Irrigation	3778, 3779, 4427, 4489, 5049, 5057, 5627, 5638	349	0
Roberts	Irrigation	3787	640	72
Sherman	Irrigation	3794, 3795	275	32

[1.] for non-consumptive uses

Red River Basin

The run-of-river flows for the Red River Basin were determined by using the TCEQ WAM Run 3 downloaded October 21, 2014. The flows were determined as the minimum annual diversion from the river. Table C-12 below shows the availability by county.

Table C-12: Red River Basin Run-of-River Availability

County	Use	Water Rights	Permitted Diversion (Acre-Feet/ Year)	Total Run-of-River (Acre-Feet/ Year)
Carson	Irrigation	5239, 5240, 5241, 5242, 5243	335[1]	277
Childress	Irrigation	5223	38.5	19
Collingsworth	Irrigation	4184, 4198, 4207, 5235, 5236, 5237, 5256, 5257, 5258, 5259, 5260, 5261	1,194	851
Donley	Irrigation	4576, 5232, 5234	464	166
Gray	Irrigation	5246, 5251	130	55
Hall	Irrigation	5107	101	52
Randall	Irrigation	5181, 5189, 5190, 5191, 5192, 5194, 5195	1,072	217
Randall	Municipal	5022	2	0
Wheeler	Irrigation	4130, 4193, 4194, 5247, 5248, 5249, 5250, 5252, 5253, 5254, 5262, 5264	1,048	603

[1.] plus 110 Ac-ft/yr authorized recapture of produced groundwater

Appendix D

2016 Panhandle Regional Water Plan Task 5 Report: Agricultural Water Management Strategies

2016 Panhandle Regional Water Plan Task 5 Report:
Agricultural Water Management Strategies

Steve Amosson, Shyam Nair, Bridget Guerrero and Thomas Marek[1]

Agriculture is the primary user of water in the Panhandle Water Planning Area (PWPA). Agriculture is projected to account for 92% of the total water use in the PWPA in 2020. Counties with irrigation shortages in the region are projected to reach 156,704 acre-feet per year in 2020 and be 148,520 acre-feet per year deficit by 2070. Given the limited renewability of aquifers in the area, there is no readily available water supply in or near the high demand irrigation counties that could be developed to fully meet these shortages. Therefore, water management strategies for reducing irrigation demands in the Ogallala Aquifer for all 21 counties in the PWPA were examined. These strategies focus on Dallam, Hartley, and Moore Counties, which are the only counties in the region showing water demands that cannot be met with existing supplies, along with Sherman County, which is another major irrigation demand county that was projected to have a minimal surplus, Table 1. Hopefully, the use of irrigation management strategies and local groundwater rules will prolong the life of irrigated agriculture within these counties.

Table1: Irrigation Shortages by County Identified in the PWPA, 2020-2070.

County	Projected Need (acre-feet per year)					
	2020	2030	2040	2050	2060	2070
Dallam	79,399	91,675	94,226	87,452	77,836	68,218
Hartley	77,305	93,368	98,650	92,699	83,415	74,130
Moore	0	0	0	0	3,882	6,171
Sherman*	0	0	0	0	0	0

*Sherman has a small surplus of 32 acre-feet in each decade.

Methodology

Water savings, implementation cost, savings from reduced pumping and the impact in gross crop receipts were estimated for each proposed water management strategy evaluated in the planning effort and described in the forthcoming sections. The year 2013 was selected as the baseline for evaluating strategies. Baseline adoption rates for strategies were estimated using secondary data sources and future adoption rates (2020 – 2070) were identified under the guidance of the Panhandle Water Planning Group (PWPG) Agriculture committee, Table 2. Since final implementation rates of conservation strategies do not occur until 2070, the water savings, direct cost and net cost of all strategies were evaluated over a 60-year planning horizon (2020 – 2079). A five-year average (2006 – 2010) of Farm Service Agency (FSA) irrigated acreage for the region was used to establish a baseline from which effectiveness of alternative conservation strategies were measured. FSA irrigated acreage estimates were increased in some counties based on local knowledge to account for farms known not to be registered with FSA. The five-

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year average of irrigated acreage was used to dampen distortions resulting from acreage shifts between crops caused by volatile crop prices. Water availability was assumed to remain constant in measuring the impacts of the various water conservation strategies.

In addition, the Agricultural subcommittee of the PWPG identified three combinations of the previously mentioned strategies that may likely be employed in irrigation deficit counties. The combinations of strategies were: 1) change in crop type, irrigation scheduling, and changes in irrigation equipment; 2) changes in crop variety, irrigation scheduling, and changes in irrigation equipment; and 3) change in crop type, advances in plant breeding, irrigation scheduling, and changes in irrigation equipment. When implementing multiple strategies the impact on potential water savings are not additive in most instances. The cumulative water savings from use of multiple strategies was estimated using a stepwise procedure; first revising water use after implementing one strategy and then using the revised water use as the base before introducing the second strategy and repeating the process for the third and fourth strategy. For example, the impact of changing crop type on water use was estimated, then based on the revised water use, the impact of scheduling was identified and water use revised again, and based on this estimate, the effectiveness of changes in irrigation equipment was made. The water savings of the three combinations of strategies considered was done for the four identified counties and the region as a whole. In examining the cost effectiveness of the strategy combinations (done on a regional basis), it was assumed the cost was additive.

Implementation costs were defined as the costs that could be borne by producers and/or the government associated with implementing a strategy. The savings in pumping cost takes into the account the variable cost savings from the reduced irrigation. The variable cost of irrigation is assumed be $9.10 per acre-inch (Texas A&M AgriLife Crop and Livestock Budgets, 2014). All costs were evaluated in 2014 dollars. The loss in gross receipts was estimated by strategy, where warranted. The impact on the regional economy resulting from a change in gross receipts was not estimated but is discussed.

Table 2: Estimated Potential Water Savings and Future Adoption Percentage of Water Conservation Strategies, 2013-2070

Water Management Strategy	Annual Regional Water Savings (% of irrigation or ac-inch/ac/yr.)	Assumed Baseline Use 2013	Goal for Adoption 2020	Goal for Adoption 2030	Goal for Adoption 2040	Goal for Adoption 2050	Goal for Adoption 2060	Goal for Adoption 2070
Irrigation Scheduling	10%	20%	35%	50%	75%	85%	90%	95%
Irrigation Equipment Changes	Furrow to MESA or LESA 3.5	87%	90%	91.5%	93%	94.5%	96%	98%
	MESA or LESA to LEPA or SDI 1.3	75%	80%	85%	90%	95%	100%	100%
Change in crop type	7.8-8.6	10%	15%	20%	25%	30%	35%	40%
Change in crop variety	4.10 (corn) 3.0 (sorghum)	40%	50%	60%	70%	70%	70%	70%
Conversion to Dryland	13.9	0%	2.5%	5%	5%	5%	5%	5%
Soil Management	1.75	70%	75%	80%	85%	90%	95%	95%
Advances in Plant Breeding	Corn, cotton, and soybean 15% (2020-2030) 30% starting in 2040	0%	50%	75%	85%	95%	95%	95%
	Wheat and sorghum 12% starting in 2030	0%	0%	50%	75%	85%	95%	95%
Precipitation Enhancement	1.0	38%	38%	38%	38%	38%	38%	38%

Description of Agricultural Conservation Strategies

In this plan, the Agriculture subcommittee of the PWPG identified eight potential agricultural water conservation strategies to be evaluated. These strategies include: irrigation scheduling; irrigation equipment changes; change in crop type; change in crop variety; conversion to dryland; soil management; advances in plant breeding for drought tolerance; and precipitation enhancement. Precipitation enhancement is considered a limited use strategy since it cannot be implemented by an individual producer and little interest has been shown in implementing this strategy by ground water districts in the region with the exception of the Panhandle Groundwater Conservation District. A description of each of these strategies is presented in the following sections.

Irrigation Scheduling

Irrigation scheduling refers to the process of allocating irrigation water according to crop requirements based on meteorological demands and field conditions with the intent to manage and conserve water, control disease infestations, and maximize farm profit. In a region like the Panhandle, where irrigation water availability is increasingly becoming limited, proper and accurate irrigation scheduling is critical to ensure profitable agricultural production and conservation of the existing water resources. Soil water measurement-based methods, plant stress sensing-based methods, and weather-based methods are the common irrigation scheduling tools. The prevalent soil-based irrigation scheduling method utilized in the region today employs soil moisture probes that estimate soil moisture at different depths to schedule irrigation. Irrigation scheduling based on crop evapotranspiration reported by ET networks in the region is also an important weather-based irrigation scheduling method since this data references the climatic demand, which varies annually and can vary substantially within the season. Plant stress-based irrigation scheduling techniques using thermal sensors are also a developing irrigation scheduling strategy but are not yet widespread in use. The soil moisture probe and thermal sensor methods can allow for automation of irrigation scheduling by wireless connection of the sensors to respective irrigation systems. Proper and accurate irrigation scheduling can save up to 2 to 3 acre-inches of irrigation per year for corn. In this analysis, the water savings from this strategy is assumed to be 10% of the water applied for each crop.

The cost of irrigation scheduling can vary significantly depending on several factors including the level of service, equipment costs, and area served. More money tends to be invested in irrigation scheduling of higher value crops. A range of $3.00 to $12.00 per acre for irrigation scheduling was identified based on discussions with industry representatives, depending on the level of service. In this analysis, a $5.00 per acre annual cost was assumed for irrigation scheduling. Irrigation scheduling costs can be reduced if the producer choses to buy the soil moisture probe. Typically, the cost of a soil moisture probe ranges from $1,300 to $2,650, depending on the company and level of sophistication of the probe.

Irrigation Equipment Changes

Current irrigation methods practiced in the Texas Panhandle include conventional furrow irrigation (CF), center pivot irrigation (MESA: Mid Elevation Spray Application, LESA: Low Elevation Spray Application, and LEPA: Low Elevation Precision Application) and subsurface drip irrigation (SDI).The average application efficiency of CF, MESA, LESA, LEPA, and SDI is 60, 78, 88, 95, and 97%, respectively (Amosson et al., 2011). These application efficiencies are the percentage of irrigation water applied that is used by the crop with the remainder being lost to runoff, evaporation or deep percolation. Switching from low efficiency irrigation systems such as CF and MESA to more efficient irrigation systems such as LEPA and SDI improves the efficiency of irrigation system water use and can help conserve groundwater resources. Switching irrigation systems can be a costly strategy to conserve irrigation water, but that cost can be partially offset by the decrease in pumping cost. The water conservation strategy of changing irrigation equipment includes establishing new MESA and LESA systems in CF irrigated fields and converting MESA and LESA to LEPA to improve its application efficiency. Establishing MESA, LESA, LEPA, or SDI systems requires a major investment, while converting MESA and LESA to LEPA using conversion kits are comparatively less expensive.

The regional water savings estimate in 2020 from this strategy is 3.5 and 1.3 acre-inches per acre for conversion of furrow to MESA/LESA and MESA/LESA to LEPA, respectively. It should be noted that water savings from this strategy vary by county and over time as the amount of water pumped changes.

Initial investment in irrigation equipment varies depending on the dealer and spacing between sprinkler drops or tape in the case of SDI. In consultation with industry representatives and other secondary sources, the cost of adding a quarter-mile (125 acres) sprinkler system was estimated to be $75,000-$80,000. The estimates to convert a MESA or LESA quarter-mile sprinkler system to LEPA ranged from $7,000-$10,000, depending on the spacing of the drops. The estimates for installing a SDI system ranged from $1,200-$1,500 per acre, depending primarily on whether drip tapes were spaced 80 inches or 40 inches apart.

The implementation cost of this strategy is estimated using the costs associated with the irrigation equipment required for each of the systems and their respective adoption rate. The total cost (fixed cost + variable cost) of applying one acre-inch of water per acre for intermediate water use for furrow, MESA, LESA, LEPA, and SDI are $12.26, $13.98, $13.60, $13.76, and $17.04, respectively (Amosson et al., 2011). These values were inflated to 2014 values using price index for farm machinery (USDA, 2014). The assumed adoption percentage of the irrigation systems during each decade was used along with the acreage and average water use to estimate the amount of irrigation applied using these systems during the baseline period and future periods. These irrigation amounts were multiplied with the cost per acre-inch to get the total cost of irrigation during the baseline and future time periods. The difference in cost between successive time periods is the cost of implementation for this strategy.

Change in crop type

There are considerable differences in water requirements among different crops. Selection of crops with lower water requirements can be an effective water conservation strategy. Corn, cotton, wheat, and grain sorghum are the four major crops in the Panhandle region accounting for about 90% of the irrigated acreage. Corn has one of the highest water requirements of any irrigated crop grown in the Texas High Plains because of a longer growing season than most other spring crops, which can adversely affect yield in limited moisture situations (Howell et al., 1996). The seasonal evaporative demand for corn is 28 to 32 inches, for wheat is 26 to 28 inches, for cotton is 13 to 27 inches, and for grain sorghum is 13 to 24 inches. To date, the majority of water used for irrigation has been applied to high water use crops such as corn. On the other hand, cotton, wheat, and grain sorghum can tolerate lower moisture availability and are more suited to deficit irrigation practices. Considerable amounts of irrigation water can be saved by shifting from high water use crops like corn to lower water use crops like cotton, wheat or grain sorghum. In this analysis, it is assumed that shifting from corn to low water use crops can save 7.8-8.6 acre-inches per acre depending on the crop choice.

The cost of implementing this water conservation strategy is evaluated in terms of an "opportunity cost" expressed by the reduced land values which reflect the water availability required to produce crops. Land that has "good" water availability to support corn production is worth more compared to the land with "fair" availability of water that can support cotton, wheat, or grain sorghum. Hence the cost of adoption of this strategy for one acre of land is estimated as the difference between the average land value in the region for irrigated cropland with good water availability and that of irrigated cropland with fair water availability. This per acre cost of adoption is then multiplied by the assumed acreage of adoption to get the total cost. The total cost is divided by the estimated water savings to get the cost incurred by producers to generate an acre-foot of water savings. The land values reported by the Texas chapter of the American Society of Farm Managers and Rural Appraisers (ASFMRA, 2013) provided the average land value for these two classes of irrigated cropland in the region. ASFMRA (2013) reported that the value of irrigated cropland with good water availability in the region ranges from $2,800 to $4,000 per acre. The average of these two values ($3,400) was used as the average land value for irrigated cropland with good water availability in the region. The value of irrigated cropland with fair water availability in the region ranges from $1,800 to $2,500 per acre. The average of these two prices ($2,150) was used as the average land value for irrigated cropland with fair water availability in the region.

Change in crop variety

The evaporative demand for short season varieties can be significantly lower than that for long season varieties. Short season varieties of corn and grain sorghum use less water than the conventional longer season varieties. Thus, converting from long season varieties to short season varieties of corn and grain sorghum can be a useful water conservation strategy. In addition, short season hybrids may be seeded earlier to possible avoid insect threat, and have the potential of planting a third crop in two years either by planting a short season variety prior to or following a wheat crop (Howell et al., 1996). Early planting of the short season hybrids can also help avoid high evaporative demand periods and save water. The seasonal evapotranspiration for short season corn hybrids was found to be generally 5 inches less than that of long season hybrids (Howell et al., 1998). The water use of short season grain sorghum is about 0.6 inches less than that of long season varieties. Therefore, considerable water savings can be realized by substituting long season varieties of corn and grain sorghum with the short season varieties. In this analysis, the water savings from adopting short season corn and short season grain sorghum are assumed to be 4.1 and 3.0 acre-inches per acre, respectively.

The implementation cost of this water conservation strategy was assumed to be the compensation needed to account for the loss in yield and profitability of employing the strategy. Howell et al. (1998) reported that the yield from short season hybrids was about 15% less than that from the full season hybrids. A partial budget analysis considering the loss in revenue versus the reduction in pumping cost, fertilizer, and harvest expense indicates that approximately half of the revenue reduction is profit loss (Texas A&M AgriLife Crop and Livestock Budgets, 2014). In this analysis, the loss of revenue from short season corn and grain sorghum is estimated as 15% of the average revenue for the last 5 years and the implementation cost is assumed to be half of that amount. The average revenue was calculated using the average corn and grain sorghum yield and the average price received in Northern High Plains for last 5 years (USDA, 2014). It should be noted that the reduction in gross receipts and associated expenditures is expected to have a negative impact on the regional economy.

Conversion to Dryland

The strategy of converting from irrigated crop production to dryland crop production would save all of the irrigation water normally used on irrigated acreage. Converting from an irrigated to dryland cropping system may be a viable economic alternative for some producers in the Panhandle on marginally irrigated lands or as a regional strategy to conserve water reserves. The primary dryland crops grown in the area are winter wheat, grain sorghum, and cotton. Conversion programs that provide incentives to conversion to dryland, identifying and adopting crops that perform well in the region under rainfed conditions, and developing higher yielding heat and drought-tolerant varieties will be critical in implementing this strategy. Other highly drought tolerant crops like canola, safflower, mustard, camelina, jatropha, castor, guar, and rapeseed are currently being evaluated for suitability and profitability, but sustained markets and returns on investments are still valid concerns. This analysis assumes 13.9 acre-inches per acre water savings by the adoption of this strategy over the entire region; however, the amount varies by county depending on crop composition.

The cost of implementing this water conservation strategy is evaluated in terms of reduced land values. Land that has sufficient water available for irrigation is worth much more compared to dry cropland. Therefore, the cost of adoption of this strategy for one acre of land is estimated as the difference between the average land value in the region for irrigated cropland and that of dryland. This per acre cost of adoption is then multiplied by the assumed acreage of adoption to get the total cost. The land values reported by the Texas chapter of the American Society of Farm Managers and Rural Appraisers (ASFMRA, 2013) provided the average land value for irrigated and dry cropland in the region. The value of irrigated cropland with fair water availability in the region ranges from $1,800 to $4,000 per acre. The average of these two values ($2,900) was used as the average land value for irrigated cropland availability in the region. The average land value of dry cropland ranged from $500 to $700 per acre in the western parts of the region and from $700 to $1,100 in the Eastern parts of the region resulting in an overall average of $750 per acre. Therefore, the cost assumed in the analysis to retire an acre of irrigated land was $2,150 ($2,900 - $750). In addition to the implementation cost, the loss in gross receipts from the conversion of irrigated to dryland crop production was estimated.

Soil Management

Effective soil management practices can increase the efficiency of both irrigation and rainfall events, increase soil infiltration, reduce runoff, reduce evaporative loss, and conserve moisture available within the soil profile. Thus, these practices promote efficient use of the available water and enhance crop production and sustainability of the region's natural resources. Conservation tillage practices, furrow diking, and introduction of fallow and low water use crops in the crop rotation are the most important land management practices that can lead to water conservation within the region.

Conservation tillage is defined as tillage practices that minimize soil and water loss by maintaining a surface residue cover of more than 30% on the soil surface (CTIC, 2014). Conservation tillage can reduce evaporation, increase rainfall infiltration, water storage, soil moisture conservation, and water use efficiency. Conservation tillage systems are also reported to have economic advantages as it reduces machinery, fuel, and labor costs. Conservation tillage is a term covering a wide range of tillage practices with the common characteristic of reduced soil and water loss. Different tillage practices such as minimum tillage, reduced tillage, no-till;

ridge tillage, vertical tillage, and strip tillage are often interchangeably used with the term conservation tillage. In this analysis, the water savings from adopting effective soil management strategy is assumed to be 1.75 acre-inches per acre.

The initial capital investment in equipment may impede the adoption of soil management practices. The purchase price of conservation tillage equipment capable of doing strip till or vertical tillage varies considerably depending on the size and company that made it. For example, a six-row strip till implement costs approximately $32,000, whereas a 24-row prices out at $116,500 (Texas A&M AgriLife Crop and Livestock Budgets, 2014). A 14-foot vertical tillage implement costs $39,000, where a 40-foot version priced out at $116,500. The appropriate size of conservation implements depends upon the equipment compliment of the producer.

The implementation cost of soil management strategy is estimated as the difference between the cost of conventional tillage and conservation tillage. It is assumed that the average conventionally tilled field will be disked once, chiseled once, and cultivated three times during the year. This will be followed by two herbicide applications; one pre-plant and one post-plant. In the case of conservation tillage (strip tillage is assumed as it is most common in the region), it is assumed that the field is chiseled once and cultivated two times. There are three herbicide applications in conservation tillage; one burn down, one pre-plant, and one post-plant application. The cost of disc ploughing, chiseling, and cultivation are $12.09, $12.61, and $10 per acre, respectively (Texas Agricultural Custom Rates, 2013). The cost of burn down, pre-plant, and post plant herbicide application are assumed to be $19.50, $17.36, and $15.69 per acre, respectively (Texas A&M AgriLife Crop and Livestock Budgets, 2014). The cost of conventional and conservation tillage are calculated using this data as $87.75 and $85.16 per acre, respectively.

Advances in Plant Breeding

Plant breeding has played a major role in increasing crop productivity and enhancing the efficiency of inputs such as irrigation. Previously, plant breeding efforts were mainly concentrated on hybridization and selection to produce improved planting materials like composite seeds and F1 hybrid seeds. The success stories in this era were hybrid corn and semi dwarf varieties of wheat and rice that triggered the green revolution. The advances made in genetic engineering led to the plant biotechnology era, which began in the 1980s when transgenic plants were produced. Transgenic planting materials for several crops are commercially available now. The commercial varieties for several crops with genetically modified organisms (GMOs) are also widely in use. From a water conservation standpoint, varieties with higher water use efficiency and enhanced drought tolerance can lead to substantial water savings. The adoption of drought resistant varieties with high water use efficiency can be a potential water conservation strategy. The first wave of drought resistant varieties for corn, cotton, and soybeans are expected to be released by 2020 followed by a second wave in 2040 that will improve drought and heat tolerance even more. This analysis assumes that the first round of drought resistant varieties will reduce water use by 15% and the second round of varieties will reduce the water use an additional 15% compared to current varieties. It is also assumed that drought tolerant varieties of wheat and grain sorghum will be available by 2030 and will reduce the water use by 12%.

The implementation cost of this strategy assumed an additional cost of drought resistant seed estimated at a dollar for every one percent reduction in water use. Therefore it was assumed a 15 percent reduction in water use is will cost $15 per acre and a 30 percent reduction will cost $30 per acre. Cost estimates were made after consultation with industry personnel and researchers working in the area. These costs were then multiplied with the annual total acreage for corn, cotton and soybeans, affected by incorporation of this strategy. It is also assumed that drought tolerant varieties of wheat and grain sorghum will cost $12/acre for a 12 percent reduction in water use.

Precipitation Enhancement

Precipitation enhancement, commonly known as cloud seeding or weather modification, is a process in which clouds are inoculated with condensation agents (such as silver iodide) to enhance rainfall formation. Cloud seeding is also used as a technique for hail suppression or reducing hailstone size (Encyclopedia Britannica, 2014). Currently, cloud seeding is conducted in almost one-fifth of the land area of Texas, covering about 31 million acres. In 2012, the weather modification programs in Texas conducted 162 missions, treating 353 thunderstorms. Analysis showed that the treated storms lived 40% longer, covered 47% more area, and produced 124% more rain than the untreated storms. The estimated increase in water availability was 1,517,266 acre-feet at a cost of $11/acre-foot (TDLR, 2014). Precipitation enhancement can help conserve groundwater by reducing the irrigation requirement. It can also increase reservoir levels and could have positive impact on dryland farms and ranches. This analysis assumes a water savings of one acre-inch per acre for all irrigated acreage in the region by precipitation enhancement.

The strategy of precipitation enhancement is adopted only by the counties in the Panhandle Groundwater Conservation District (PGCD). In consultation with PGCD personnel, the cost of adoption of this strategy per acre feet of water saved is estimated as $6.28 in the 2006 plan. Since this was a local estimate of the cost it was determined to be more accurate than the TDRL cost for the area. This 2006 PGCD value was adjusted to 2014 dollars (USDA, 2014). The cost of adoption of this strategy per acre-foot of water saved is estimated to be $8.11

Results

Cumulative water savings, implementation cost, reduced cost and the change in gross receipts for each of the water conservation strategies and combinations of strategies are presented in Table 3. An excess of 61 million acre feet of water is projected to be utilized for irrigation within the region over the 50-year planning horizon (2020 – 2070) without adoption of any new conservation strategies or increases in the implementation level of current strategies. Since final implementation rates of conservation strategies do not occur until 2070, the water savings, direct cost and net cost of all strategies were evaluated over a 60-year planning horizon (2020 – 2079). Each of the conservation strategies is discussed in order of projected magnitude of water savings followed by the combinations of strategies that were considered.

Anticipated advances in plant breeding (drought resistant varieties) in corn, cotton, sorghum, soybeans and wheat were estimated to generate by far the largest amount of water savings, 13.8 million ac-ft., which was 22.6 percent of the total irrigation water pumped over the 60-year planning horizon. Implementing this strategy was expected to cost $113.3 million resulting in an average cost of $8.20 per ac-ft. of water saved. The reduction in pumping cost ($1.5 billion) is expected to more than offset the implementation cost.

The change in crop type was estimated to generate 6.4 million ac-ft. of water savings, which was 10.5 percent of the total irrigation water pumped over the 60-year planning horizon. Implementing this strategy was expected to cost $199.9 million resulting in an average cost of $31.27 per ac-ft. of water saved. The difference in land values used to estimate implementation costs inherently takes into account reduced pumping costs, therefore, no additional benefit with respect to cost savings was identified. However, achieving these water savings came at an additional cost. The move to lower productive crops resulted in a loss in gross crop receipts of $3.0 billion, resulting in a negative impact on the regional economy.

Proper and accurate irrigation scheduling can save up to 2 to 3 acre-inches of irrigation per year for corn. In this analysis, the water savings from this strategy is assumed to be 10% of the water applied for each crop. Increased use of irrigation scheduling to improve the water use efficiency was estimated to save 4.7 million ac-ft. or approximately 7.7 percent of total water pumped. Implementation costs were estimated at $209.4 million resulting in a cost per ac-ft. of water saved of $44.69. The resultant reduction in pumping cost was estimated at $511.6 million, which is more than double the implementation cost.

Table 3: Estimated Water Savings and Costs Associated with Proposed Water Conservation Strategies in Region A

Water Management Strategy	Cumulative Water Savings (WS)	Implementation Cost (IC)	IC/WS	Cost Savings	Net Cost/WS	Loss in Gross Receipts
	ac-ft.	$1,000	$/ac-ft.	$1,000	$/ac-ft.	$1,000
Irrigation Scheduling	4,685,325	209,396	$44.69	511,637	($64.51)	-
Change in Crop Variety	3,064,326	602,294	$196.55	-	$196.55	1,204,587
Irrigation Equipment Changes	3,643,928	55,638	$15.27	397,917	($93.93)	-
Change in Crop Type	6,394,663	199,934	$31.27	-	$31.27	3,006,360
Soil Management	1,970,123	(34,989)	($17.76)	215,137	($126.99)	-
Precipitation Enhancement	813,923	6,601	$8.11	88,880	($101.09)	-
Irrigated to Dryland Farming	4,156,337	145,226	$34.94	-	$34.94	2,805,477

Advances in Plant Breeding	13,821,966	113,322	$8.20	1,509,359	($102.63)	-
Change in Crop Type, Irrigation Scheduling & Irrigation Equipment	13,602,712	265,034	$19.48	1,485,416	($89.72)	3,006,360
Change in Crop Variety, Irrigation Scheduling & Irrigation Equipment	10,325,042	867,328	$84.00	1,127,495	($25.20)	1,204,587
Change in Crop Type, Advances in Plant Breeding, Irrigation Scheduling & Irrigation Equipment	22,928,545	378,356	$16.50	2,503,797	($92.70)	3,006,360

Converting irrigated land to dryland production yielded water savings of 4.2 million ac-ft. or 6.9 percent of the total pumped. The estimated change in land values resulted in an implementation cost of $145.2 million and a resultant cost of $34.94 per ac-ft. of water saved. Since the implementation cost was evaluated as a change in land values it can be deduced that any value attributed to reduced pumping is captured in the change in land prices, therefore, no additional savings for reduced pumping cost was calculated. The change in land use from irrigated to dryland resulted in a considerable loss in gross receipts that was estimated at $2.8 billion dollars over the planning horizon which would be a significant negative impact on the regional economy.

Additional conversion of non-efficient irrigation delivery systems in the region, such as furrow to MESA and MESA to more efficient systems (LESA, LEPA, or subsurface drip irrigation) resulted in a savings of 3.6 million ac-ft. (7.7 percent of total irrigation water pumped). Investment in these more efficient systems results in an implementation cost of $55.6 million which translates into a cost of $15.27 per ac-ft. of water saved. The savings producers may capture from reduced pumping cost was estimated at $ 397.9 million resulting in a net cost savings of $342.3 million. This strategy was not expected to have any adverse effects on gross receipts while increasing investment and reducing pumping cost, thus, having a slightly positive impact on the regional economy.

The change to shorter season corn and sorghum varieties yielded the sixth largest water savings of 3.1 million ac-ft. or 5.1 percent of the total pumped. The implementation cost for this strategy which was assumed to be the loss in producer profitability was estimated at $602.3 million. Change in producer returns was used in calculating the implementation cost which included the benefits of reduced pumping costs; therefore, no additional savings were credited to this strategy. In addition, changing crop variety leads to lower yields that reduce gross cash receipts ($1.2

billion) which has a negative impact on the regional economy. The results of this strategy are very dependent on the yield reductions of short season varieties and crop prices. Lower prices and yield reductions increase the feasibility of this strategy.

The soil management conservation strategy encompasses a number of activities from including fallow in a rotation to the adoption of conservation tillage. Increasing the level of soil management yielded water savings of 2.0 million ac-ft. or 3.3 percent of total irrigation water pumped. The implementation cost of increased soil management was assessed by evaluating the cost differential between conventional and reduced till. The change in relative cost of fuel and chemicals and conservation tillage methods has made conservation tillage more cost effective than conventional tillage while achieving water savings. The implementation of increased conservation tillage was estimated to reduce costs $35.0 million over the planning horizon, resulting in a negative cost per acre-foot of water saved (-$17.76). The savings in pumping costs ($215.1 million) added to the viability of this strategy reducing the cost per acre-foot of water saved (-$126.99).

The precipitation enhancement strategy was projected to save 813,923 ac-ft. under the assumption that increased rainfall would result in a one acre-inch reduction in pumping. The estimated implementation cost associated with this strategy was $6.6 million resulting in a cost of $8.11 per ac-ft. of water saved. It should be noted that the total cost of this strategy is more than stated since it is used to benefit all land including dryland crops and pasture and only the proportional cost was attributed to the irrigated land. The savings in pumping cost was estimated at $88.9 million. This strategy should yield a positive impact to gross receipts in the region, since additional rainfall will occur not only on irrigated land but on dryland and pasture operations increasing their productivity. It should be noted, that unlike the other strategies considered, this is not a strategy a producer can individually adopt. Currently, only the Panhandle Groundwater Conservation District practices precipitation enhancement in Region A, and there are no indications that other districts of the region plan to incorporate this strategy.

The Ag subcommittee of PWPG identified three combinations of strategies that may likely be used in deficit irrigated counties. These strategies were also evaluated for the region as a whole. The combination of change in crop type, irrigation scheduling, and irrigation equipment resulted in an estimated water savings of 13.6 million ac-ft. or 22.6 percent of the total pumped; the strategy of implementing changes in crop variety, irrigation scheduling, and irrigation equipment was projected to save 10.3 million ac-ft. or 16.9 percent of the total pumped; and the combination of change in crop type, advances in plant breeding, irrigation scheduling, and irrigation equipment had estimated water savings of 22.9 million ac-ft. or 37.5 percent of the total pumped. The interaction between some strategies results in lower water savings from implementing multiple strategies. It was estimated that the water savings from the combinations of strategies versus the additive water savings was reduced 7.5 percent, 10.4 percent and 19.5 percent, respectively, while the pumping cost savings ranged from 1.1 to 2.5 billion over the planning horizon for these combinations. It should be noted that all three combinations involved either change in crop type or a change in crop variety which results in a decrease in gross receipts having a negative impact on the regional economy.

Dallam County: Irrigation Shortages and Water Savings from Conservation Strategies

It is projected that Dallam County will have an irrigation shortage of 78,969 ac-ft. in 2020 (Table 4). This annual shortfall will increase to 93,817 ac-ft. in 2040 before falling to 67,839 ac-ft. by 2070. Advances in plant breeding was the most effective water saving strategy evaluated when fully implemented in Dallam County reducing annual use by 82,123 ac-ft. It was projected this strategy would meet the projected shortage by 2060. The effectiveness of the remaining strategies once fully implemented ranked as follows: change in crop type (50,048 ac-ft.), irrigation scheduling (27,734 ac-ft.), irrigation equipment (23,484 ac-ft.), conversion to dryland (18,489 ac-ft.), change in crop variety (16,142 ac-ft.) and soil management (10,737 ac-ft.). Precipitation enhancement was not considered a viable option for the county.

Three combinations of strategies identified by the Ag subcommittee of PWPG were evaluated. However, it is important to understand that implementation of certain strategies can diminish the effectiveness of others if they are also implemented. The combination of change in crop type, advances in plant breeding, irrigation scheduling, and irrigation equipment was estimated to be the most effective meeting the projected shortage by 2040 and generating a surplus of 72,773 ac-ft. (140,612 - 67,839) in 2070. While less effective, the combination of change in crop type, irrigation scheduling, and irrigation equipment was able to cover the projected shortage by 2060, however, the strategy of implementing changes in crop variety, irrigation scheduling, and irrigation equipment was unable to generate sufficient water savings to offset shortages in the time periods.

Table 4: Dallam County Projected Annual Irrigation Shortage and Water Savings by Strategy (acre-ft./year), 2020-2070.

		2020	**2030**	**2040**	**2050**	**2060**	**2070**
Projected Irrigation Demand		290,465	255,849	224,569	195,921	170,116	144,312
Projected Shortage		-79,399	-91,675	-94,226	-87,452	-77,836	-68,218
Projected Water Savings							
Water Saving Strategies	Change in Crop Type	8,341	16,683	25,024	33,365	41,707	50,048
	Change in Crop Variety	5,381	10,761	16,142	16,142	16,142	16,142
	Soil Management	2,147	4,295	6,442	8,590	10,737	10,737
	Conversion to Dryland	9,245	18,489	18,489	18,489	18,489	18,489
	Irrigation Equipment	5,947	9,635	13,579	15,566	20,841	23,484
	Irrigation Scheduling	5,547	11,094	20,338	24,036	25,885	27,734
	Precipitation Enhancement	0	0	0	0	0	0
	Advances in Plant Breeding	19,445	33,500	72,708	81,256	82,123	82,123
	Change in Crop Type, Irrigation Scheduling & Irrigation Equipment	18,554	34,891	54,501	67,115	81,034	92,438
	Change in Crop Variety, Irrigation Scheduling & Irrigation Equipment	15,371	28,653	45,278	50,309	56,603	60,638
	Change in Crop Type, Advances in Plant Breeding, Irrigation Scheduling & Irrigation Equipment	34,218	61,174	106,343	121,011	132,167	140,612

Hartley County: Irrigation Shortages and Water Savings from Conservation Strategies

It is projected that Hartley County will have an irrigation shortage of 77,305 ac-ft. in 2020 (Table 5). This annual shortfall will increase to 98,650 ac-ft. in 2040 before falling to 74,130 ac-ft. by 2070. Advances in plant breeding was the most effective water saving strategy evaluated when fully implemented in Hartley County reducing annual use by 66,615 ac-ft. It was projected that this strategy by itself would not meet the projected shortage during the modeling time horizon thus, implementing a combination of strategies will be required to meet irrigation needs. The effectiveness of the remaining strategies once fully implemented ranked as follows: change in crop type (41,054 ac-ft.), irrigation scheduling (25,895 ac-ft.), irrigation equipment (21,928 ac-ft.), conversion to dryland (17,263 ac-ft.), change in crop variety (13,218 ac-ft.) and soil management (9,320 ac-ft.). Precipitation enhancement was not considered a viable option for the county.

Three combinations of strategies identified by the Ag subcommittee of PWPG were evaluated. However, it is important to understand that implementation of certain strategies can diminish the effectiveness of others if they are also implemented. The combination of change in crop type, advances in plant breeding, irrigation scheduling, and irrigation equipment was estimated to be the most effective meeting the projected shortage by 2050 and generating a surplus of 46,379 ac-ft. in 2070. While less effective, the combination of change in crop type, irrigation scheduling, and irrigation equipment was able to cover the projected shortage only in the last year modeled (2070), however, the strategy of implementing change in crop variety, irrigation scheduling, and irrigation equipment was unable to generate enough water savings to offset shortages in the time periods.

Table 5: Hartley County Projected Annual Irrigation Shortage and Water Savings by Strategy (acre-ft./year), 2020-2070.

		2020	2030	2040	2050	2060	2070
	Projected Irrigation Demand	268,060	232,514	201,640	174,225	150,144	126,063
	Projected Shortage	-77,305	-93,368	-98,650	-92,699	-83,415	-74,130
	Projected Water Savings						
Water Saving Strategies	Change in Crop Type	6,842	13,685	20,527	27,369	34,211	41,054
	Change in Crop Variety	4,406	8,812	13,218	13,218	13,218	13,218
	Soil Management	1,864	3,728	5,592	7,456	9,320	9,320
	Conversion to Dryland	8,632	17,263	17,263	17,263	17,263	17,263
	Irrigation Equipment	5,553	8,996	12,679	14,535	19,460	21,928
	Irrigation Scheduling	5,179	10,358	18,990	22,442	24,169	25,895
	Precipitation Enhancement	0	0	0	0	0	0
	Advances in Plant Breeding	15,812	27,154	59,014	65,927	66,615	66,615
	Change in Crop Type, Irrigation Scheduling & Irrigation Equipment	16,448	30,857	48,401	59,374	71,566	81,413
	Change in Crop Variety, Irrigation Scheduling & Irrigation Equipment	13,837	25,741	40,843	45,606	51,565	55,385
	Change in Crop Type, Advances in Plant Breeding, Irrigation Scheduling & Irrigation Equipment	29,197	52,161	90,476	103,095	113,047	120,509

Moore County: Irrigation Shortages and Water Savings from Conservation Strategies

It is projected that Moore County will have adequate water available for irrigation until 2040 when a deficit of 4,960 ac-ft. will occur (Table 6). This annual shortfall will increase to 12,764 ac-ft. in 2070. As standalone strategies, implementing advances in plant breeding or change in crop type were sufficient to meet projected deficits in all time periods considered with estimated annual savings 32,271 ac-ft. and 19,951 ac-ft., respectively, by 2070. The effectiveness of the remaining strategies once fully implemented ranked as follows: irrigation scheduling (10,716 ac-ft.), irrigation equipment (9,081 ac-ft.), change in crop variety (7,685 ac-ft.), conversion to dryland (7,144 ac-ft.) and soil management (5,194 ac-ft.). Precipitation enhancement was not considered a viable option for the county.

Three combinations of strategies identified by the Ag subcommittee of PWPG were evaluated. However, it is important to understand that implementation of certain strategies can diminish the effectiveness of others if they are also used. Implementing any of the three combinations of strategies was sufficient to meet projected shortages. The combination of change in crop type, advances in plant breeding, irrigation scheduling, and irrigation equipment was estimated to be the most effective generating a surplus of 42,642 ac-ft. in 2070. While less effective, the combination of change in crop type, irrigation scheduling, and irrigation equipment and the strategy of implementing changes in crop variety, irrigation scheduling, and irrigation equipment also were sufficient generating annual surpluses of 23,606 ac-ft. and 11,629 ac-ft., respectively, by 2070.

Table 6: Moore County Projected Annual Irrigation Shortage and Water Savings by Strategy (acre-ft./year), 2020-2070.

		2020	**2030**	**2040**	**2050**	**2060**	**2070**
	Projected Irrigation Demand	143,035	134,402	123,297	109,598	92,010	76,022
	Projected Shortage	7	7	7	7	-3,882	-6,171
	Projected Water Savings						
Water Saving Strategies	Change in Crop Type	3,325	6,650	9,976	13,301	16,626	19,951
	Change in Crop Variety	2,562	5,124	7,685	7,685	7,685	7,685
	Soil Management	1,039	2,078	3,117	4,155	5,194	5,194
	Conversion to Dryland	3,572	7,144	7,144	7,144	7,144	7,144
	Irrigation Equipment	2,300	3,726	5,251	6,020	8,059	9,081
	Irrigation Scheduling	2,143	4,286	7,858	9,287	10,001	10,716
	Precipitation Enhancement	0	0	0	0	0	0
	Advances in Plant Breeding	7,446	13,321	28,560	31,763	32,271	32,271
	Change in Crop Type, Irrigation Scheduling & Irrigation Equipment	7,276	13,693	21,372	26,349	31,849	36,370
	Change in Crop Variety, Irrigation Scheduling & Irrigation Equipment	6,341	11,862	18,614	20,507	22,875	24,393
	Change in Crop Type, Advances in Plant Breeding, Irrigation Scheduling & Irrigation Equipment	13,308	24,120	41,895	47,571	52,037	55,406

Sherman County: Irrigation Shortages and Water Savings from Conservation Strategies

It is projected that Sherman County will have adequate but marginal surplus of water available for irrigation throughout the planning horizon (Table 7). Therefore, implementing any of the conservation strategies will only add to the surplus. The effectiveness of the individual strategies once fully implemented ranked as follows: advances in plant breeding (49,844 ac-ft.), change in crop type (28,639 ac-ft.), irrigation scheduling (16,450 ac-ft.), irrigation equipment (14,030 ac-ft.), conversion to dryland (10,967 ac-ft.), change in crop variety (9,325 ac-ft.) and soil management (6,739 ac-ft.). Precipitation enhancement was not considered a viable option for the county.

Three combinations of strategies identified by the Ag subcommittee of PWPG were evaluated. However, it is important to understand that implementation of certain strategies can diminish the effectiveness of others if they are also used. The combination of change in crop type, advances in plant breeding, irrigation scheduling, and irrigation equipment was estimated to be the most effective, generating an estimated annual water savings relative to the baseline of 83,721 ac-ft. in 2070. While less effective, the combination of change in crop type, irrigation scheduling, and irrigation equipment and the strategy of implementing changes in crop variety, irrigation scheduling, and irrigation equipment also generated substantial annual savings of 54,121 ac-ft. and 35,802 ac-ft., respectively, by 2070.

Table 7: Sherman County Projected Annual Irrigation Shortage and Water Savings by Strategy (acre-ft./year), 2020-2070.

		2020	**2030**	**2040**	**2050**	**2060**	**2070**
	Projected Irrigation Demand	220,998	207,789	190,719	169,531	148,344	127,157
	Projected Shortage	32	32	32	32	32	32
	Projected Water Savings						
Water Saving Strategies	Change in Crop Type	4,773	9,546	14,320	19,093	23,866	28,639
	Change in Crop Variety	3,108	6,217	9,325	9,325	9,325	9,325
	Soil Management	1,348	2,696	4,043	5,391	6,739	6,739
	Conversion to Dryland	5,484	10,967	10,967	10,967	10,967	10,967
	Irrigation Equipment	3,553	5,756	8,112	9,300	12,451	14,030
	Irrigation Scheduling	3,290	6,580	12,064	14,257	15,354	16,450
	Precipitation Enhancement	0	0	0	0	0	0
	Advances in Plant Breeding	11,572	20,447	44,121	49,226	49,844	49,844
	Change in Crop Type, Irrigation Scheduling & Irrigation Equipment	10,876	20,435	31,957	39,312	47,470	54,121
	Change in Crop Variety, Irrigation Scheduling & Irrigation Equipment	9,048	16,859	26,664	29,657	33,401	35,802
	Change in Crop Type, Advances in Plant Breeding, Irrigation Scheduling & Irrigation Equipment	20,156	36,498	63,651	72,285	78,846	83,721

Additional Irrigation Supply from Groundwater Wells

While the PWPG does not recommend new groundwater wells as a strategy to meet future irrigation needs during the planning period, drilling of new wells is an option for irrigation water users who require additional supplies. Approximate cost estimates were developed to determine the expense associated with installing irrigation wells. Calculations assumed a well with a depth of 375 feet, pumping at less than 700 gpm costs $95 per foot; and pumping equipment is estimated at $75 per foot. At the 500 foot well depth level, drilling cost was estimated at $110 per foot and pumping equipment cost estimates varied as to whether a submersible or electric turbine was employed (personal communication with Curry Drilling). Table 8 summarizes two scenarios: a pumping rate of less than and greater than 700 gallons per minute.

Table 8: Estimated Costs of Irrigation Wells in Region A

Pumping Rate (gpm)	Approximate Well Depth (ft.)	Approximate Well Casing Diameter (in.)	Approximate Pumping Unit Diameter (in.)	Well Cost	Pumping Equipment Cost	Total Cost
Less than 700	375	12¾	4 - 6	$33,750	$25,500	$59,250
Greater than 700	500	16	8	$55,000 $55,000	$54,500[1] $61,000[2]	$109,500 $116,000

[1] Assumes submersible pump and associated equipment
[2] Assumes electric turbine and associated equipment

Summary of Irrigation Conservation Strategies

Prioritizing and implementing the eight irrigation conservation strategies will depend on the individual irrigator and regional support for the strategy. The one strategy that yields the largest water savings is the adoption of drought resistant varieties of corn, cotton, sorghum, soybeans and wheat which are being developed with the aid of advances in plant breeding. It is estimated to have the potential to save 13.8 million ac-ft. (cumulative savings), which was 22.6 percent of the total irrigation water pumped over the 60-year planning horizon and is significantly more than the other strategies evaluated. The cumulative effectiveness of the remaining strategies in millions of ac-ft. ranked as follows: change in crop type (6.4), irrigation scheduling (4.7), conversion to dryland (4.2), irrigation equipment (3.6), change in crop variety (3.1), soil management (2.0) and precipitation enhancement (0.8).

Implementation cost can be a critical barrier to the adoption or rate of adoption of water conservation strategies. The estimated cost of implementing the various strategies expressed in $/ac-ft. of water savings varied considerably. The cost of implementing soil management actually was negative suggesting producers would save money by utilizing soil conservation techniques (-$17.76 per ac-ft.). Precipitation enhancement, advances in plant breeding, and irrigation equipment were the next three most cost effective strategies at $8.11, $8.20 and $15.27 per ac-ft., respectively. The remaining strategies where implementation cost where identified included change in crop type, conversion to dryland and irrigation scheduling had implementation costs estimated at $31.27, $34.94 and $44.69 per ac-ft., respectively.

Water savings generated by conservation strategies not only help meet regional goals for water conservation but have a direct benefit to producers through reduced pumping costs. Savings in pumping cost exceeded the estimated cost of implementation for five of the strategies leading to a negative net cost per acre foot of water saved. These strategies were; soil management (-$126.99), advances in plant breeding (-$102.63), precipitation enhancement (-$101.09), irrigation equipment (-$93.93) and irrigation scheduling (-$64.51). This suggests these strategies may be readily adopted if the implementation cost can be overcome. The remaining three strategies, change in crop variety, conversion to dryland and change in crop type had a positive net cost to implementation indicating more significant monetary enticements will be necessary to encourage adoption of these strategies.

Water conservation strategies can have significantly different impacts on the regional economy which is often measured by the change in gross receipts or costs. The impact on the regional economy should be a major consideration in prioritizing strategies to be implemented. In this planning effort, no attempt was made to quantify the impacts of individual strategies on the regional economy; however, the anticipated direction of effect(s) was included. Change in crop type, change in crop variety and conversion to dryland are all anticipated to have a negative impact due to the reduction in production. The remaining five conservation strategies are all expected to have a positive impact due to a reduction in costs without reducing yields leading to a "freeing up" of income to be spent in the economy.

The counties of Dallam, Hartley and Moore are projected to have irrigation shortfalls while Sherman is expected to have a marginal surplus. None of the individual or combinations of strategies evaluated was able to generate sufficient water savings to cover projected deficits in the near term (prior to 2050) in Dallam and Hartley Counties. Once fully in place, two of the combinations of strategies yielded sufficient water savings to overcome the projected deficits in later years. The two combinations were; change in crop type, advances in plant breeding, irrigation scheduling, and irrigation equipment and change in crop type, irrigation scheduling and irrigation equipment. In Moore County, implementing advances in plant breeding or change in crop type or any of the three combinations of strategies were sufficient to meet projected deficits in all time periods while employing one or any combination of identified water conservation strategies will add to the projected surplus in Sherman County.

Several caveats to this analysis need to be mentioned. First, the associated water savings with these strategies are "potential" water savings. In the absence of water use constraints, most of the strategies considered will simply increase gross receipts. In fact, the improved water use efficiencies generated from some of these strategies may actually increase the depletion rate of the Ogallala Aquifer. Second, potential water savings may be overestimated when combinations of strategies are implemented. For example, the savings associated with the implementation of irrigation equipment efficiency improvements cannot be applied to irrigated land that is converted to dryland farming. In this analysis, the decrease in water savings from using multiple conservation strategies is estimated for three combinations. Finally, precipitation enhancement is not a strategy that a producer can implement. It has to be funded and implemented by a group such as a water district. Currently, only the Panhandle Groundwater Conservation District practices precipitation enhancement. At this time, none of the other water districts have any plans to adopt precipitation enhancement; therefore, estimated water savings may be overestimated depending on location.

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Appendix E

Cost Estimates

Region A Regional Water Planning Area Cost Estimates

As part of the 2011 PWPA Regional Water Plan, cost estimates were developed for each of the recommended water management strategies in Region A. As appropriate, these cost estimates have been updated for the 2016 regional water plan. In accordance with the Texas Water Development Board guidance the costs for water management strategies are to be updated from second quarter 2008 dollars to September 2013 dollars. The methodology used to develop the 2016 costs is described in the following sections. Where updated unit costs were not available, the Engineering News Record (ENR) Index for construction was used to increase the costs from second quarter 2008 (September) costs to September 2013 costs. An increase of 111.6% from September 2008 to September 2013 was determined using the ENR Index method.

Introduction

1. The evaluation of water management strategies requires developing cost estimates. Guidance for cost estimates may be found in the TWDB's "First Amended General Guidelines for Regional Water Plan Development (2012-2017)", Section 5.1. Costs are to be reported in September 2013 dollars.

2. Standard unit costs for installed pipe, pump stations, standard treatment facilities, and well fields were developed and/or updated using the costing tool provided by the TWDB. The unit costs do not include engineering, contingency, financial and legal services, costs for land and rights-of-way, permits, environmental and archeological studies, or mitigation. The costs for these items are determined separately in the cost tables.

3. The information presented in this section is intended to be 'rule-of-thumb' guidance. Specific situations may call for alteration of the procedures and costs. Note that the costs in this memorandum provide a planning level estimate for comparison purposes.

4. It is important that when comparing alternatives that the cost estimates be similar and include similar items. If an existing reliable cost estimate is available for a project it should be used where appropriate. All cost estimates must meet the requirements set forth in the TWDB's "First Amended General Guidelines for Regional Water Plan Development (2012-2017)".

5. The cost estimates have two components:

   - Initial Capital Costs: Including total construction cost of facilities, engineering and legal contingencies, environmental and archaeology studies and mitigation, land acquisition and surveying, and interest incurred during construction (4.0% annual interest rate less a 1.0% rate of return on investment of unspent funds).

- Average Annual Costs: Including annual operation and maintenance costs, pumping energy costs, purchase of water and debt service.

TWDB does not require the consultant to determine life cycle or present value analysis. For most situations annual costs are sufficient for comparison purposes and a life-cycle analysis is not required.

ASSUMPTIONS FOR CAPITAL COSTS:

Conveyance Systems

The unit costs and factors shown in Tables 1-7 were developed directly from the TWDB costing tool. These costs are the basis of the capital costs developed for this plan. Standard pipeline costs used for these cost estimates are shown in Table 1. Pump station costs are based on required Horsepower capacity and are listed in Table 2. The power capacity is to be determined from the hydraulic analyses included in the TWDB costing tool (or detailed analysis if available). Pipelines and pump stations are to be sized for peak pumping capacity.

- Pump efficiency is assumed to be 70 percent.
- Peaking factor of 2 times the average demand is to be used for strategies when the water is pumped directly to a water treatment plant. (or historical peaking factor, if available)
- The target flow velocity in pipes is 5 fps and the Hazen-Williams Factor is assumed to be 120.
- Peaking factor of 1.2 to 1.5 can be used if there are additional water sources and/or the water is transported to a terminal storage facility.
- Ground storage is to be provided at each booster pump station along the transmission line unless there is a more detailed design.
- Ground storage tanks should provide sufficient storage for 2.5 to 4 hours of pumping at peak capacity. Costs for ground storage are shown in Table 3. Covered storage tanks are used for all strategies transporting treated water.

Water Treatment Plants

Water treatment plants are to be sized for peak day capacity (assume peaking factor of 2 if no specific data is available). Costs estimated include six different treatment levels of varying degree. These levels are groundwater chlorine disinfection, iron and manganese removal, simple filtration, construction of a new conventional treatment plant, expansion of a conventional treatment plant, brackish desalination, and seawater desalination. Costs are also based upon a TDS factor that will increase or decrease the cost of treatment accordingly. These costs are summarized in Table 4. **All treatment plants are to be sized for finished water capacity**.

Direct Reuse

Direct reuse refers to the introduction of reclaimed water directly from a water reclamation plant to a distribution system. The following assumptions were made for direct potable and non-potable reuse strategies.

Direct Non-Potable Reuse

Non-potable reuse is the use of reclaimed water that is used directly for non-potable beneficial uses such as landscape irrigation. The TWDB costing tool currently does not have a direct non-potable reuse treatment plant improvements option, therefore the following assumptions were made.

- It was assumed that the cost of an iron and manganese removal plant would be an appropriate approximation of the improvements that would be needed at the Wastewater Treatment Plant. This cost was further refined by assuming that only upgrades to an existing facility would be required, and not construction of an entirely new plant.
- Approximately two miles of 6-inch pipeline was also included in the cost estimates for transport of the treated water to the destination. Since reuse is still relatively new, there is a lack of piping infrastructure for reuse water. It was also assumed that the pump station was included in the WWTP improvements.

Direct Potable Reuse

Direct potable reuse is the use of reclaimed water that is transported directly from a wastewater treatment plant to a drinking water system. The TWDB costing tool currently does not have a direct potable reuse treatment plant improvements option, therefore the following assumptions were made.

- Due to the high level of treatment that is required for direct potable reuse, the wastewater treatment plant improvements cost was assumed to be equivalent to 75% of a conventional treatment plant expansion plus brackish desalination treatment improvements. The 25% discount was given to Level 3 Treatment in order to alleviate any redundancy being assumed by the costing tool.

New Groundwater Wells

Cost estimates required for water management strategies that include additional wells or well fields were determined through the TWDB costing tool (unless a more detailed design was available). The associated costs are shown in Table 5. The costing tool differentiated the wells based upon purpose. The categories were Public Supply, Irrigation, and ASR. These cost relationships are “rule-of-thumb” in nature and are only appropriate in the broad context of the cost evaluations for the RWP process.

The cost relationships assume construction methods required for public water supply wells, including carbon steel surface casing and pipe-based, stainless steel, and wire-wrap screen. The cost estimates assume that wells would be gravel-packed in the screen sections and the surface casing cemented to their total depth. Estimates include the cost of drilling, completion, well development, well testing, pump, motor, motor controls, column pipe, installation and mobilization. The cost relationships do not include engineering, contingency, financial and legal services, land costs, or permits. A more detailed cost analysis should be completed prior to developing a project.

The costs associated with conveyance systems for multi-well systems can vary widely based on the distance between wells, terrain characteristics, well production, and distance to the treatment facility. These costs should be estimated using standard engineering approaches and site-specific information. For planning purposes, these costs were estimated using the TWDB costing tool’s assumptions for conveyance. It is important to note that conveyance costs were not included for point of use water user groups such as mining.

Other Costs

- Engineering, contingency, construction management, financial and legal costs are to be estimated at 30 percent of construction cost for pipelines and 35 percent of construction costs for pump stations, treatment facilities and reservoir projects. (This is in accordance with TWDB guidance.)
- Permitting and mitigation for transmission and treatment projects are to be estimated at $25,000 per mile. For reservoirs, mitigation and permitting costs are assumed equal to twice the land purchase cost, unless site specific data is available.

- Right-of-way (ROW) costs for transmission lines are estimated through costs provided by the Texas A&M University Real Estate Center (http://recenter.tamu.edu/data/rland/) which gives current land costs based on county. The ROW width is assumed to be 20 ft. If a small pipeline follows existing right-of-ways (such as highways), no additional right-of-way cost may be assumed. Large pipelines will require ROW costs regardless of routing.

Interest during construction is the total of interest accrued at the end of the construction period using a 4.0 percent annual interest rate on total borrowed funds, less a 1 percent rate of return on investment of unspent funds. This is calculated assuming that the total estimated project cost (excluding interest during construction) would be drawn down at a constant rate per month during the construction period. Factors were determined for different lengths of time for project construction. These factors were used in cost estimating and are presented in Table 6.

ASSUMPTIONS FOR ANNUAL COSTS:

Annual costs are to be estimated using the following assumptions:

- Debt service for all transmission and treatment facilities is to be annualized over 20 years, but not longer than the life of the project. [Note: uniform amortization periods should be used when evaluating similar projects for an entity.]
- Annual interest rate for debt service is 5.5 percent.
- Water purchase costs are to be based on wholesale rates reported by the selling entity when possible. In lieu of known rates, a typical regional cost for treated water and raw water will be developed.
- Operation and Maintenance costs are to be calculated based on the construction cost of the capital improvement. Engineering, permitting, etc. should not be included as a basis for this calculation. However, a 20% allowance for construction contingencies should be included for all O&M calculations. Per the "First Amended General Guidelines for Regional Water Plan Development (2012-2017)", O&M should be calculated at:
    - 1 percent of the construction costs for pipelines
    - 1.5 percent for dams
    - 2.5 percent of the construction costs for pump stations
    - O&M Costs for the varying levels of water treatment plant improvements were developed by the TWDB and are shown in Table 7.
- Pumping costs are to be estimated using an electricity rate of $0.09 per Kilowatt Hour. If local data is available, this can be used.

Table 1

Pipeline Costs

Diameter	Soil		Rock	
	Rural	Urban	Rural	Urban
(Inches)	($/Foot)	($/Foot)	($/Foot)	(Feet)
6	$18	$25	$22	$30
8	$28	$39	$34	$47
10	$31	$44	$38	$53
12	$35	$48	$41	$58
14	$46	$64	$55	$78
16	$57	$81	$68	$97
18	$68	$97	$83	$116
20	$81	$112	$96	$135
24	$103	$144	$123	$172
30	$137	$191	$164	$230
36	$170	$239	$204	$287
42	$204	$286	$246	$343
48	$239	$334	$286	$401
54	$273	$382	$327	$457
60	$306	$429	$368	$515
66	$358	$501	$430	$602
72	$419	$587	$504	$705
78	$490	$687	$589	$825
84	$574	$804	$689	$965
90	$672	$941	$806	$1,129
96	$772	$1,082	$927	$1,298
102	$865	$1,211	$1,038	$1,453
108	$952	$1,332	$1,142	$1,599
114	$1,047	$1,465	$1,256	$1,758
120	$1,152	$1,612	$1,382	$1,934
132	$1,324	$1,854	$1,589	$2,225
144	$1,523	$2,132	$1,828	$2,559

Table 2
Pump Station Costs

Horsepower	Booster PS Cost ($-million)	Intake PS cost ($-millions)
0	$0.00	$0.00
5	$0.62	$0.67
10	$0.68	$0.72
20	$0.72	$0.77
25	$0.75	$0.82
50	$0.79	$1.03
100	$0.83	$1.55
200	$1.67	$2.06
300	$1.83	$2.58
400	$2.32	$3.09
500	$2.39	$3.61
600	$2.45	$4.12
700	$2.52	$4.64
800	$2.97	$5.15
900	$3.08	$5.67
1,000	$3.20	$6.18
2,000	$4.33	$8.66
3,000	$5.46	$10.00
4,000	$6.60	$11.34
5,000	$7.73	$12.37
6,000	$8.87	$13.40
7,000	$10.00	$14.43
8,000	$11.13	$15.46
9,000	$12.27	$16.49
10,000	$13.40	$17.52
20,000	$24.74	$28.86
30,000	$29.69	$38.13
40,000	$37.11	$48.44
50,000	$46.39	$57.72
60,000	$55.67	$66.99
70,000	$66.80	$77.30

Note:
1. Intake PS costs include intake and pump station.
2. Adjust pump station costs upward if the pump station is designed to move large quantities of water at a low head (i.e. low horsepower).
3. Assumed multiple pump setup for all pump stations.

Table 3
Ground Storage Tanks

Tank Volume (MG)	With Roof ($)	Without Roof ($)
0.05	$178,301	$118,524
0.1	$192,730	$174,179
0.5	$412,257	$374,123
1	$698,776	$618,386
1.5	$967,774	$674,041
2	$1,236,772	$803,902
2.5	$1,339,836	$922,426
3	$1,442,900	$1,040,950
3.5	$1,649,029	$1,154,320
4	$1,855,158	$1,267,691
5	$2,061,286	$1,463,513
6	$2,370,479	$1,752,093
7	$2,782,736	$2,009,754
8	$3,194,994	$2,370,479
10	$3,997,864	$3,071,316
12	$4,997,331	$3,916,444
14	$6,021,017	$4,740,958

Note: Costs assume steel tanks smaller than 1 MG, concrete tanks 1 MG and larger.

Table 4
Conventional Water Treatment Plant Costs

	Level 0	Level 1	Level 2	Level 3 (new)	Level 3 (exp)	Level 4	Level 5
	Chlorine Disinfection (GW)	Iron & Manganese Removal	Simple Filtration	Conventional Treatment	Conventional Treatment	Brackish Desalination	Seawater Desalination
Capacity (MGD)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)	Capital Cost ($)
0	0	0	0	0	0	0	0
0.1	17,948	224,345	1,030,643	1,373,739	1,373,739	916,221	2,202,644
1	69,098	900,371	3,607,251	4,844,022	4,844,022	3,664,883	14,738,196
10	440,703	3,747,009	19,066,897	32,980,578	18,551,575	24,777,648	98,615,306
50	2,203,515	10,882,523	72,145,015	135,606,271	66,991,800	94,233,468	372,343,747
75	3,305,272	15,701,003	105,469,141	199,327,155	106,502,260	131,935,273	520,364,186
100	4,407,030	19,236,530	138,793,267	261,974,046	129,095,574	167,517,457	659,848,640
150	6,610,545	29,438,241	205,441,519	385,074,680	193,640,235	234,539,403	922,162,931
200	8,814,060	33,898,368	272,089,771	506,100,496	238,822,748	297,793,331	1,169,350,182

Note: Plant is sized for finished peak day capacity.

Table 5
Cost Elements for Water Wells

Public Supply Well Costs						
	Well Capacity (MGD)					
Well Depth (ft)	100	175	350	700	1000	1800
150	$124,138	$188,450	$321,561	$363,439	$453,177	$662,565
300	$167,510	$239,301	$382,882	$438,220	$541,419	$767,259
500	$216,867	$299,127	$454,672	$523,472	$644,618	$892,892
700	$261,736	$352,969	$518,984	$601,244	$737,347	$1,003,569
1000	$343,996	$451,681	$638,635	$743,330	$909,345	$1,209,967
1500	$481,594	$617,696	$836,059	$981,135	$1,193,515	$1,550,971
2000	$619,192	$782,216	$1,033,482	$1,218,941	$1,479,181	$1,893,471
Irrigation Well Costs						
150	$68,800	$106,190	$180,972	$207,893	$263,231	$379,891
300	$91,234	$136,103	$221,353	$261,736	$332,031	$463,646
500	$113,669	$170,502	$264,727	$320,065	$406,812	$560,863
700	$131,615	$195,928	$302,118	$369,422	$472,620	$644,618
1000	$171,998	$252,762	$379,891	$471,124	$602,740	$809,137
1500	$240,797	$349,979	$508,515	$640,130	$818,111	$1,081,342
2000	$308,100	$444,203	$637,139	$807,642	$1,034,978	$1,355,043
ASR Well Costs						
150	$137,598	$212,379	$369,422	$417,282	$520,480	$767,259
300	$180,972	$263,231	$430,742	$492,063	$608,723	$873,449
500	$230,327	$324,553	$502,532	$577,315	$713,417	$997,587
700	$276,692	$378,395	$568,341	$655,087	$804,651	$1,109,759
1000	$357,456	$477,107	$686,496	$797,173	$976,649	$1,314,662
1500	$496,550	$641,627	$883,919	$1,034,978	$1,260,819	$1,655,665
2000	$632,653	$806,146	$1,081,342	$1,272,783	$1,546,484	$1,998,165

Table 6
Factors for Interest During Construction

Construction Period	Factor
6 months	0.0175
12 months	0.035
18 months	0.0525
24 months	0.07
36 months	0.105
48 month	0.14
60 months	0.175
72 months	0.21
84 months	0.245

Table 7
Annual Water Treatment Plant O&M Costs

	Level 0	Level 1	Level 2	Level 3 (New)	Level (Exp)	Level 4	Level 5
Capacity (MGD)	**Chlorine Disinfection (GW)**	**Iron & Manganese Removal**	**Simple Filtration**	**Conventional Treatment**	**Conventional Treatment**	**Brackish Desalination**	**Seawater Desalination**
0	0	0	0	0	0	0	0
0.1	5,384	37,017	103,064	68,687	68,687	83,293	374,449
1	20,729	148,561	360,725	242,201	242,201	333,171	2,505,493
10	132,211	618,256	1,906,690	1,649,029	927,579	2,252,513	16,764,602
50	661,054	1,795,616	7,214,502	6,780,314	3,349,590	8,566,679	63,298,437
75	991,582	2,590,666	10,546,914	9,966,358	5,325,113	11,994,116	88,461,912
100	1,322,109	3,174,027	13,879,327	13,098,702	6,454,779	15,228,860	112,174,269
150	1,983,163	4,857,310	20,544,152	19,253,734	9,682,012	21,321,764	156,767,698
200	2,644,218	5,593,231	27,208,977	25,305,025	11,941,137	27,072,121	198,789,531

Table E-1 City of Amarillo Develop Potter County Well Field (Ogallala Aquifer)				
Owner:	City of Amarillo			
Quantity:	6,000			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Wells	12	EA	$627,000	$7,524,000
Well Field Collection Pipeline(s)	211,200	LF	$88	$18,660,000
Connection to Existing Infrastructure	26,400	LF	$301	$7,944,000
Pump Station Upgrade	1	EA	$1,500,000	$1,500,000
Storage Tank (3 MG)	2	EA	$1,443,000	$2,886,000
Total Capital Costs				**$38,514,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering and Contingencies (30% for pipeline)				$7,981,000
Engineering and Contingencies (35% for other items)				$3,644,000
Land Acquisition	273	AC	$1,200	$327,000
Permitting and Mitigation	45	MI	$25,000	$1,125,000
Interest During Construction (12 months)				$1,806,000
Groundwater Rights/ Purchase				$0
TOTAL CAPITAL COST				**$53,397,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$4,468,000
Electricity				$468,000
Water Treatment O&M				$75,000
Operation and Maintenance				$632,000
Total Annual Cost				**$5,643,000**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$941**
Water Cost ($ per 1,000 gallons)				**$2.89**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$196**
Water Cost ($ per 1,000 gallons)				**$0.60**

Table E-2
City of Amarillo
Develop Carson County Well Field (Ogallala Aquifer)

Owner:	City of Amarillo			
Quantity:	11,200			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Wells	18	EA	$673,000	$12,114,000
Well Field Collection Pipeline(s) (range 8" to 30")	95,040	LF	$63	$5,998,000
Connection to Existing Infrastructure (42")	15,840	LF	$226	$3,575,000
Storage Tank	0	EA	$699,000	$0
Pump Station Overhaul	1	EA	$1,000,000	$1,000,000
Total Capital Costs				**$22,687,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering and Contingencies (30% for pipeline)				$2,872,000
Engineering and Contingencies (35% for other items)				$4,590,000
Land Acquisition	145	AC	$1,200	$174,000
Permitting and Mitigation	21	MI	$25,000	$525,000
Interest During Construction (12 months)				$1,080,000
Groundwater Rights/ Purchase	11,200	Ac-Ft	$500	$5,600,000
TOTAL CAPITAL COST				**$37,528,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$3,140,000
Electricity				$1,160,000
Water Treatment O&M				$132,000
Operation and Maintenance				$508,000
Total Annual Cost				**$4,940,000**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$441**
Water Cost ($ per 1,000 gallons)				**$1.35**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$161**
Water Cost ($ per 1,000 gallons)				**$0.49**

Table E-3
City of Amarillo
Develop Roberts County Well Field (Ogallala Aquifer)

Owner:	City of Amarillo			
Quantity:	11,200			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Wells	18	EA	$584,000	$10,512,000
Well Field Collection Pipeline(s) (12" to 42")	95,040	LF	$88	$8,397,000
Connection to Existing Infrastructure (42")	396,000	LF	$226	$89,366,000
Storage Tank (3 MG)	2	EA	$1,443,000	$2,886,000
Pump Station	2	EA	$6,030,000	$12,060,000
Total Capital Costs				**$123,221,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering and Contingencies (30% for pipeline)				$29,329,000
Engineering and Contingencies (35% for other items)				$8,910,000
Land Acquisition	564	AC	$1,200	$676,000
Permitting and Mitigation	93	MI	$25,000	$2,325,000
Interest During Construction (12 months)				$5,756,000
Groundwater Rights/ Purchase				$0
TOTAL CAPITAL COST				**$170,217,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$14,244,000
Electricity				$910,000
Water Treatment O&M				$132,000
Operation and Maintenance				$1,937,000
Total Annual Cost				**$17,223,000**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$1,538**
Water Cost ($ per 1,000 gallons)				**$4.72**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$266**
Water Cost ($ per 1,000 gallons)				**$0.82**

Table E-4
City of Amarillo
Direct Reuse

Owner:	City of Amarillo			
Quantity:	6,100	AF/Y	**(5.45 MGD Average)**	
Capital Costs	**Quantity**	**Units**	**Unit Price**	**Cost**
20- inch pipeline	36,960	LF	$124	$4,572,000
8 MGD Pre-Treatment WTP	1	EA	$11,629,000	$11,629,000
8 MGD RO Plant	1	EA	$21,303,000	$21,303,000
Wastewater Treatment Plant Improvements	1	LS	$2,500,000	$2,500,000
Pump Station at WWTP	1	LS	$1,500,000	$1,500,000
12 inch RO Discharge Line	36,960	LF	$54	$1,978,000
Total Capital Cost				**$43,482,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering, Legal Costs and Contingencies (30% pipelines)				$1,965,000
Engineering, Legal Costs and Contingencies (35% all other)				$12,401,200
Land Acquisition	170	Ac	$10,000	$1,697,000
Permitting and Mitigation	14	mi	$25,000	$850,000
Interest During Construction (18 months)				$3,171,000
Total Project Cost				**$63,566,200**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$5,319,000
Pipeline and Well Operation and Maintenance				$128,000
Treatment O&M				$2,601,265
Pumping Energy Costs ($0.09/kWh)				$295,000
Total Annual Cost				**$8,343,265**
UNIT COST (Until Amortized)				
Annual Cost of Water ($ per acft)				$1,368
Annual Cost of Water ($ per 1,000 gallons)				$4.20
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				$496
Water Cost ($ per 1,000 gallons)				$1.52

Table E-5 Canadian River Municipal Water Authority Replace Capacity of Roberts County Well Field (Ogallala Aquifer) in 2030				
Owner:	Canadian River Municipal Water Authority			
Quantity:	9,500	AF/Y		
Capital Costs	**Quantity**	**Units**	**Unit Price**	**Cost**
Collection Pipeline(s)	5	EA	$100,000	$500,000
Well Field(s) and Wells	5	EA	$1,087,000	$5,435,000
Total Capital Cost				**$5,935,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering, Legal Costs and Contingencies (30% for pipelines)				$150,000
Engineering, Legal Costs and Contingencies (35% for wellfield)				$1,902,250
Interest During Construction (1 year)				$280,000
Total Project Cost				**$8,267,250**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$692,000
Pipeline and Well Operation and Maintenance				$141,000
Pumping Energy Costs ($0.09/kWh)				$850,000
Total Annual Cost				**$1,683,000**
Unit Cost				
Annual Cost of Water ($ per acft)				$177
Annual Cost of Water ($ per 1,000 gallons)				$0.54

Table E-6 Canadian River Municipal Water Authority Replace Capacity of Roberts County Well Field (Ogallala Aquifer) in 2040				
Owner:	Canadian River Municipal Water Authority			
Quantity:	18,500 AF/Y			
Capital Costs:	**Quantity**	**Units**	**Unit Price**	**Cost**
Collection Pipeline(s)	10	EA	$100,000	$1,000,000
Well Field(s) and Wells	10	EA	$1,087,000	$10,870,000
Total Capital Cost				**$11,870,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering, Legal Costs and Contingencies (30% for pipelines)				$300,000
Engineering, Legal Costs and Contingencies (35% for wellfield)				$3,804,500
Interest During Construction (1 year)				$559,000
Total Project Cost				**$16,533,500**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$1,384,000
Pipeline and Well Operation and Maintenance				$282,000
Pumping Energy Costs ($0.09/kWh)				$1,654,000
Total Annual Cost				**$3,320,000**
Unit Cost				
Annual Cost of Water ($ per acft)				$179
Annual Cost of Water ($ per 1,000 gallons)				$0.55

Table E-7
Canadian River Municipal Water Authority
Expansion of Roberts County Well Field (Ogallala Aquifer) in 2024

Owner:	Canadian River Municipal Water Authority			
Quantity:	48,000 AF/Y			
Capital Costs	**Quantity**	**Units**	**Unit Price**	**Cost**
54 inch line (Amarillo)	354,486	LF	$342	$121,234,000
14 inch line (Pampa)	3,587	LF	$88	$316,000
8" Air Valve in Vault	98	EA	$14,000	$1,372,000
8" Air Valve in Vault	47	EA	$10,000	$470,000
Tunneled Crossing (72" STL Casing)	1,700	LF	$1,000	$1,700,000
Water Crossing (Slope Protected)	18	EA	$25,000	$450,000
Pipeline Connections	2	EA	$250,000	$500,000
Well Field Collection Pipeline(s)	20	EA	$100,000	$2,000,000
Well Field(s) and Wells	20	EA	$1,268,000	$25,360,000
Impressed Current Deep Well Groundbed	24	EA	$50,000	$1,182,000
54 MGD Pump Station	2	EA	$16,000,000	$32,000,000
9 MG Storage Tank	1	EA	$4,000,000	$4,000,000
Total Capital Cost				**$190,584,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Contingnecy/Land Acquisition (16%)				$30,493,000
Engineering (10%)				$19,058,000
Permitting and Mitigation	68	mi	$25,000	$1,700,000
Interest During Construction (1 year)				$8,464,000
Total Project Cost				**$250,299,000**
UNIT COST (Until Amortized)				
Debt Service (5.5 percent for 20 years)				$20,945,000
Pipeline and Well Operation and Maintenance				$2,844,000
Pumping Energy Costs ($0.09/kWh)				$8,677,000
Total Annual Cost				**$32,466,000**
Unit Cost (Until Amortized)				
Annual Cost of Water ($ per acft)				$676
Annual Cost of Water ($ per 1,000 gallons)				$2.08
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				$240
Water Cost ($ per 1,000 gallons)				$0.74

Table E-8 Canadian River Municipal Water Authority Aquifer Storage and Recovery				
Owner:	Canadian River Municipal Water Authority			
Quantity:	6,400 AF/Y			
Capital Costs:	**Quantity**	**Units**	**Unit Price**	**Cost**
16" Wellfield Pipeline(s)	220,000	EA	$63	$13,884,000
Pump Improvements	11	EA	$1,833,000	$20,163,000
Injection Wells	11	EA	$1,353,000	$14,883,000
Total Capital Cost				**$48,930,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering, Legal Costs and Contingencies (30% for pipelines)				$4,165,200
Engineering, Legal Costs and Contingencies (35% for wellfield)				$12,266,100
Interest During Construction (1 year)				$2,288,000
Total Project Cost				**$67,649,300**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$5,661,000
Pipeline and Well Operation and Maintenance				$792,000
Pumping Energy Costs ($0.09/kWh)				$743,000
Total Annual Cost				**$7,196,000**
Unit Cost (Until Amortized)				
Annual Cost of Water ($ per acft)				$1,124
Annual Cost of Water ($ per 1,000 gallons)				$3.45
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				$240
Water Cost ($ per 1,000 gallons)				$0.74

Table E-9
City of Borger
Develop New Well Field (Ogallala Aquifer)

Owner:	City of Borger			
Quantity:	6,000 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (600 GPM)	13	EA	$504,000	$6,552,000
Well Field Collection Pipeline(s)	13	EA	$100,000	$1,300,000
Connection to Pump Station	13	EA	$140,000	$1,820,000
Storage Tank (Closed)	1	EA	$2,370,000	$2,370,000
Subtotal for Wellfield and Treatment				**$12,042,000**
Transmission System				
24" Pipeline - Transmission Main	73,920	LF	$113	$8,353,000
Pump Station	1	LS	$813,000	$813,000
Subtotal for Transmission				**$9,166,000**
TOTAL CONSTRUCTION COST				**$21,208,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering and Contingencies (30% for pipelines)				$3,313,600
Engineering and Contingencies (35% for well field)				$4,044,300
Easement - Rural	34	AC	$1,200	$41,000
Permitting and Mitigation	14	MI	$25,000	$350,000
Groundwater Rights/ Purchase				$0
Interest During Construction (6 Months)				$507,000
TOTAL CAPITAL COST				**$29,463,900**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$2,466,000
Electricity				$456,100
Water Treatment				$74,641
Operation and Maintenance				$462,500
Total Annual Cost				**$3,459,241**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$577**
Water Cost ($ per 1,000 gallons)				**$1.77**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$166**
Water Cost ($ per 1,000 gallons)				**$0.51**

Table E-10
City of Cactus
Develop New Well Field (Ogallala Aquifer)

Owner:	City of Cactus			
Quantity:	5,500	AF/Y		
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (850 GPM)	8	EA	$627,000	$5,016,000
Well Field Collection Pipeline(s)	8	EA	$100,000	$800,000
Connection to Pump Station	8	EA	$140,000	$1,120,000
Storage Tank (Closed)	1	EA	$699,000	$699,000
Subtotal for Wellfield and Treatment				**$7,635,000**
Transmission System				
24" Pipeline - Transmission Main	15,840	LF	$113	$1,790,000
Pump Station	1	LS	$1,749,000	$1,749,000
Subtotal for Transmission				**$3,539,000**
TOTAL CONSTRUCTION COST				**$11,174,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering and Contingencies (30% for pipelines)				$866,500
Engineering and Contingencies (35% for well field)				$3,004,400
Easement - Rural	7	AC	$1,200	$9,000
Permitting and Mitigation	3	MI	$25,000	$75,000
Groundwater Rights/ Purchase	5,500	AC-FT	$500	$2,750,000
Interest During Construction (6 Months)				$313,000
TOTAL CAPITAL COST				**$18,191,900**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$1,522,000
Electricity				$439,100
Water Treatment				$69,116
Operation and Maintenance				$288,600
Total Annual Cost				**$2,318,816**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$422**
Water Cost ($ per 1,000 gallons)				**$1.29**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$145**
Water Cost ($ per 1,000 gallons)				**$0.44**

Table E-11
Connecting to Palo Duro Reservoir

				Percentage	
Owner:	Palo Duro River Authority			Percentage	
Quantity:	Cactus	1,744		45.0%	
	Dumas	1,356		35.0%	
	Sunray	271		7.0%	
	Gruver	116		3.0%	
	Spearman	271		7.0%	
	Stinnet	116		3.0%	
	Total	3,875		100.0%	

	Quantity	Units	Unit Price	Cost
Water Treatment Plant				
9 MGD Conventional Treatment Plant	1	LS	$29,854,000	$29,854,000
Engineering and Contingencies (35%)				$10,449,000
Subtotal for Water Treatment Plant				**$40,303,000**

	Construction	Capital	O&M
Cactus	$13,434,000	$18,136,000	$672,000
Dumas	$10,449,000	$14,106,000	$522,000
Sunray	$2,090,000	$2,821,000	$104,000
Gruver	$896,000	$1,209,000	$45,000
Spearman	$2,090,000	$2,821,000	$104,000
Stinnet	$896,000	$1,209,000	$45,000
check total	$29,855,000	$40,302,000	$1,492,000

		Quantity	Units	Unit Price	Cost
Pipeline System Components					
24" line from Res. to WTP		9,000	LF	$124	$1,113,000
24" line from WTP to Spearman		51,000	LF	$124	$6,308,000
Crossings		230	LF	$617	$142,000
Connection to Spearman		1	LS		$20,000
ROW	20	23	AC	$1,200	$28,000
Engineering and Contingencies (30%)					$2,275,000
Pipeline Subtotal at Spearman					**$9,886,000**

	Construction	Capital	Electricity ($)
Cactus	$3,339,000	$4,449,000	$90,000
Dumas	$2,597,000	$3,460,000	$70,000
Sunray	$519,000	$692,000	$14,000
Gruver	$223,000	$297,000	$6,000
Spearman	$519,000	$692,000	$14,000
Stinnet	$223,000	$297,000	$6,000
check total	$7,420,000	$9,887,000	$200,000

Table E-10, Continued					
		Quantity	**Units**	**Unit Price**	**Cost**
8" line from Spearman to Gruver		71,300	LF	$34	$2,412,000
Crossings		460	LF	$206	$95,000
Connection to Gruver		1	LS		$15,000
ROW	15	25	AC	$1,200	$30,000
Engineering and Contingencies (30%)					$757,000
Pipeline Subtotal at Gruver					**$3,309,000**
	Construction	Capital	Electricity ($)		
Cactus	$0	$0	$0		
Dumas	$0	$0	$0		
Sunray	$0	$0	$0		
Gruver	$2,412,000	$3,309,000	$4,700		
Spearman	$0	$0	$0		
Stinnet	$0	$0	$0		
check total	$2,412,000	$3,309,000	$4,700		
		Quantity	**Units**	**Unit Price**	**Cost**
24" line from Spearman to Stinnet		133,500	LF	$124	$16,512,700
Crossings		460	LF	$617	$284,000
ROW	20	61	AC	$1,200	$73,000
Engineering and Contingencies (30%)					$5,039,000
Pipeline Subtotal at Stinnet					**$21,908,700**
	Construction	Capital	Electricity ($)		
Cactus	$8,256,000	$10,954,000	$72,000		
Dumas	$6,422,000	$8,520,000	$56,000		
Sunray	$1,284,000	$1,704,000	$11,000		
Gruver	$0	$0	$0		
Spearman	$0	$0	$0		
Stinnet	$550,000	$730,000	$5,000		
check total	$16,512,000	$21,908,000	$144,000		
		Quantity	**Units**	**Unit Price**	**Cost**
8" line Stinnet Spur		83,350	LF	$34	$2,819,000
Crossings		1,680	LF	$206	$345,000
Connection to Stinnet		1	LS		$15,000
ROW	20	38	AC	$1,200	$46,000
Engineering and Contingencies (30%)					$954,000
Pipeline Subtotal at Stinnet					**$4,179,000**
	Construction	Capital	Electricity ($)		
Cactus	$0	$0	$0		
Dumas	$0	$0	$0		
Sunray	$0	$0	$0		
Gruver	$0	$0	$0		
Spearman	$0	$0	$0		
Stinnet	$2,819,000	$4,179,000	$5,900		
check total	$2,819,000	$4,179,000	$5,900		

Table E-10, Continued

		Quantity	**Units**	**Unit Price**	**Cost**
24" line from Stinnet Spur to Dumas		122,800	LF	$124	$15,189,000
Crossings		460	LF	$617	$284,000
Connection to Dumas		1	LS		$20,000
ROW	20	56	AC	$1,200	$67,000
Engineering and Contingencies (30%)					$4,648,000
Pipeline Subtotal at Dumas					**$20,208,000**
	Construction	Capital	Electricity ($)		
Cactus	$7,856,000	$10,452,000	$108,000		
Dumas	$6,111,000	$8,130,000	$84,000		
Sunray	$1,222,000	$1,626,000	$17,000		
Gruver	$0	$0	$0		
Spearman	$0	$0	$0		
Stinnet	$0	$0	$0		
check total	$15,189,000	$20,208,000	$209,000		
		Quantity	**Units**	**Unit Price**	**Cost**
8" line Sunray Spur		28,000	LF	$34	$947,000
Crossings		460	LF	$206	$95,000
Pressure Reducing Valve		1	EA		$35,000
Connection to Sunray		1	LS		$15,000
ROW	15	10	AC	$1,200	$12,000
Engineering and Contingencies (30%)					$328,000
Pipeline Subtotal at Sunray					**$485,000**
	Construction	Capital	Electricity ($)		
Cactus	0	$0	$0		
Dumas	0	$0	$0		
Sunray	$947,000	$485,000	$0		
Gruver	0	$0	$0		
Spearman	0	$0	$0		
Stinnet	0	$0	$0		
check total	$947,000	$485,000	$0		
		Quantity	**Units**	**Unit Price**	**Cost**
18" line from Dumas to Cactus		67,150	LF	$83	$5,560,000
Crossings		460	LF	$463	$213,000
Connection to Cactus		1	LS		$17,500
ROW	20	31	AC	$1,200	$37,000
Engineering and Contingencies (30%)					$1,737,000
Pipeline Subtotal at Sunray					**$7,564,500**

Table E-10, Continued

	Construction	Capital	Electricity ($)
Cactus	$5,560,000	$7,564,500	$21,700
Dumas	0	$0	$0
Sunray	0	$0	$0
Gruver	0	$0	$0
Spearman	0	$0	$0
Stinnet	0	$0	$0
check total	$5,560,000	$7,564,500	$21,700

Pump Station Components	**Quantity**	**Units**	**Unit Price**	**Cost**
9 MGD PS at intake	250	HP		$2,319,000
9 MGD PS at WTP	250	HP		$2,319,000
9 MGD PS at Spearman	400	HP		$3,092,000
8.12 MGD at Stinnet Spur	400	HP		$3,092,000
4.04 MGD at Dumas	100	HP		$1,546,000
Engineering and Contingencies (35%)				$4,329,000
Pump Station Subtotal				**$16,697,000**

Construction Costs	9 MGD PS at intake	9 MGD PS at WTP	9 MGD PS at Spearman	8.12 MGD at Stinnet Spur	4.04 MGD at Dumas
Cactus	$1,044,000	$1,044,000	$1,391,000	$1,546,000	$870,000
Dumas	$812,000	$812,000	$1,082,000	$1,202,000	$676,000
Sunray	$162,000	$162,000	$216,000	$240,000	$0
Gruver	$70,000	$70,000	$93,000	$0	$0
Spearman	$162,000	$162,000	$216,000	$0	$0
Stinnet	$70,000	$70,000	$93,000	$103,000	$0
check total	$2,320,000	$2,320,000	$3,091,000	$3,091,000	$1,546,000

Capital Costs	9 MGD PS at intake	9 MGD PS at WTP	9 MGD PS at Spearman	8.12 MGD at Stinnet Spur	4.04 MGD at Dumas
Cactus	$1,409,000	$1,409,000	$1,878,000	$2,087,000	$1,174,000
Dumas	$1,096,000	$1,096,000	$1,461,000	$1,623,000	$913,000
Sunray	$219,000	$219,000	$292,000	$325,000	$0
Gruver	$94,000	$94,000	$125,000	$0	$0
Spearman	$219,000	$219,000	$292,000	$0	$0
Stinnet	$94,000	$94,000	$125,000	$139,000	$0
check total	$3,131,000	$3,131,000	$4,173,000	$4,174,000	$2,087,000

Ground Storage Tanks	**Quantity**	**Units**	**Unit Price**	**Cost**
3 MG at WTP	1	LS	$1,041,000	$1,041,000
3 MG at Spearman	1	LS	$1,041,000	$1,041,000
2.5 MG at Stinnet Spur	1	LS	$922,000	$922,000
1.5 MG at Dumas	1	LS	$674,000	$674,000
Engineering and Contingencies (35%)				$1,287,000
Pump Station Subtotal				**$4,965,000**

Table E-10, Continued

Construction Costs	3 MG at WTP	3 MG at Spearman	2.5 MG at Stinnet Spur	1.5 MG at Dumas	
Cactus	$468,000	$468,000	$461,000	$379,000	
Dumas	$364,000	$364,000	$359,000	$295,000	
Sunray	$73,000	$73,000	$72,000	$0	
Gruver	$31,000	$31,000	$0	$0	
Spearman	$73,000	$73,000	$0	$0	
Stinnet	$31,000	$31,000	$31,000	$0	
check total	$1,040,000	$1,040,000	$923,000	$674,000	$3,677,000

Capital Costs	3 MG at WTP	3 MG at Spearman	2.5 MG at Stinnet Spur	1.5 MG at Dumas	
Cactus	$632,000	$632,000	$622,000	$512,000	
Dumas	$492,000	$492,000	$484,000	$398,000	
Sunray	$98,000	$98,000	$97,000	$0	
Gruver	$42,000	$42,000	$0	$0	
Spearman	$98,000	$98,000	$0	$0	
Stinnet	$42,000	$42,000	$41,000	$0	
check total	$1,404,000	$1,404,000	$1,244,000	$910,000	$4,962,000

TOTAL CONSTRUCTION COST	
Cactus	$61,910,500
Dumas	$42,271,000
Sunray	$8,676,000
Gruver	$5,212,000
Spearman	$4,439,000
Stinnet	$6,992,000
check total	$129,500,500

Interest During Construction (24 month)	
Cactus	$4,334,000
Dumas	$2,959,000
Sunray	$607,000
Gruver	$365,000
Spearman	$311,000
Stinnet	$489,000
check total	$9,065,000

Permitting and Mitigation	
Cactus	$479,000
Dumas	$321,000
Sunray	$76,000
Gruver	$44,000
Spearman	$34,000
Stinnet	$55,000
check total	$1,009,000

Table E-10, Continued

TOTAL CAPITAL COST	
Cactus	$66,723,500
Dumas	$45,551,000
Sunray	$9,359,000
Gruver	$5,621,000
Spearman	$4,784,000
Stinnet	$7,536,000
check total	$139,574,500

Annual Costs - Cactus	**Cost**
Debt Service (5.5 percent for 20 years)	$5,583,400
Electricity ($0.09 per kwh)	$291,700
Price to Purchase Water ($0.15 per 1,000 gal)	$85,000
Operation and Maintenance	$1,114,000
Total Annual Cost	$7,074,100
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$4,057
Water Cost ($ per 1,000 gallons)	$12.45
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$855
Water Cost ($ per 1,000 gallons)	$2.62

Annual Costs - Dumas	**Cost**
Debt Service (5.5 percent for 20 years)	$3,812,000
Electricity ($0.09 per kwh)	$210,000
Price to Purchase Water ($0.15 per 1,000 gal)	$66,000
Operation and Maintenance	$822,000
Total Annual Cost	$4,910,000
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$3,620
Water Cost ($ per 1,000 gallons)	$11.11
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$810
Water Cost ($ per 1,000 gallons)	$2.48

Table E-10, Continued	
Annual Costs - Sunray	**Cost**
Debt Service (5.5 percent for 20 years)	$783,000
Electricity ($0.09 per kwh)	$42,000
Price to Purchase Water ($0.15 per 1,000 gal)	$13,000
Operation and Maintenance	$169,000
Total Annual Cost	$1,007,000
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$3,712
Water Cost ($ per 1,000 gallons)	$11.39
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$826
Water Cost ($ per 1,000 gallons)	$2.53
Annual Costs - Gruver	**Cost**
Debt Service (5.5 percent for 20 years)	$470,000
Electricity ($0.09 per kwh)	$10,700
Price to Purchase Water ($0.15 per 1,000 gal)	$6,000
Operation and Maintenance	$79,000
Total Annual Cost	$565,700
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$4,866
Water Cost ($ per 1,000 gallons)	$14.93
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$823
Water Cost ($ per 1,000 gallons)	$2.53
Annual Costs - Spearman	**Cost**
Debt Service (5.5 percent for 20 years)	$400,000
Electricity ($0.09 per kwh)	$14,000
Price to Purchase Water ($0.15 per 1,000 gal)	$13,300
Operation and Maintenance	$36,000
Total Annual Cost	$463,300
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$1,708
Water Cost ($ per 1,000 gallons)	$5.24
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$233
Water Cost ($ per 1,000 gallons)	$0.72

Table E-10, Continued	
Annual Costs - Stinnet	**Cost**
Debt Service (5.5 percent for 20 years)	$630,600
Electricity ($0.09 per kwh)	$16,900
Price to Purchase Water ($0.15 per 1,000 gal)	$5,700
Operation and Maintenance	$91,600
Total Annual Cost	$744,800
UNIT COSTS (Until Amortized)	
Water Cost ($ per ac-ft)	$6,407
Water Cost ($ per 1,000 gallons)	$19.66
UNIT COSTS (After Amortization)	
Water Cost ($ per ac-ft)	$982
Water Cost ($ per 1,000 gallons)	$3.01

Table E-12 Greenbelt Municipal and Industrial Water Authority Ogallala Aquifer in Donley County				
Owner:	Greenbelt Municipal Water Authority			
Quantity:	2,000 AF/Y			
Capital Costs	**Quantity**	**Units**	**Unit Price**	**Cost**
16 inch Pipeline from North Ogallala toWTP	80,083	LF	$69	$5,499,000
Wellfield infrastructure pipelines	2	EA	$100,000	$200,000
Wells	2	EA	$755,000	$1,510,000
0.5 MG Storage Tank	1	EA	$467,000	$467,000
Electricity Connection	1	LS	$100,000	$100,000
Groundwater rights	2,000	AC	$500	$1,000,000
CONSTRUCTION TOTAL				**$8,776,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering and Contingencies (30% for pipelines)				$1,710,000
Engineering and Contingencies (35% for well field)				$727,000
Right of Way Easements (ROW)	80,083	LF	$5.00	$400,000
Permitting and Mitigation	15	MI	$25,000	$375,000
Interest During Construction (1 year)				$629,000
TOTAL PROJECT COST				**$12,617,000**
ANNUAL COSTS				
Debt Service (5.5 percent for 20 years)				$1,056,000
Electricity ($0.09 kWh)				$92,844
Operation & Maintenance				$109,540
Total Annual Costs				**$1,258,384**
UNIT COSTS				
UNIT COSTS (Pre Amort.)				
Per Acre-Foot				$629.19
Per 1,000 Gallons				$1.93
UNIT COSTS (Post Amort.)				
Per Acre-Foot				$101
Per 1,000 Gallons				$0.31

Table E-13
City of Claude
Develop Ogallala Aquifer Supplies

Owner:	City of Claude			
Quantity:	400 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (300 GPM)	2	EA	$283,508	$567,000
8" Well Field Piping	2,000	LF	$31	$62,000
Connection to Pump Station	2	EA	$140,000	$280,000
Subtotal for Wellfield and Treatment				**$909,000**
Transmission System				
8" Pipeline - Transmission Main	13,200	LF	$31	$409,000
Pump Station	1	LS	$728,000	$728,000
Subtotal for Transmission				**$1,137,000**
TOTAL CONSTRUCTION COST				**$2,046,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering and Contingencies (30% for pipelines)				$161,800
Engineering and Contingencies (35% for well field)				$551,300
Easement - Rural	6	AC	$1,200	$7,000
Permitting and Mitigation	3	MI	$25,000	$75,000
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$50,000
TOTAL CAPITAL COST				**$2,891,100**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$242,000
Electricity				$11,200
Water Treatment				$9,763
Operation and Maintenance				$53,000
Total Annual Cost				**$315,963**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$790**
Water Cost ($ per 1,000 gallons)				**$2.42**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$185**
Water Cost ($ per 1,000 gallons)				**$0.57**

Table E-14 City of Panhandle Develop Ogallala Aquifer Supplies				
Owner:	City of Panhandle			
Quantity:	600 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (475 GPM)	2	EA	$616,000	$1,232,000
Well Field Collection Pipeline(s)	2	EA	$100,000	$200,000
Subtotal for Wellfield and Treatment				**$1,432,000**
Transmission System				
Pump Station	1	LS	$696,000	$696,000
Subtotal for Transmission				**$696,000**
TOTAL CONSTRUCTION COST				**$2,128,000**
Engineering and Contingencies (30% for pipelines)				$60,000
Engineering and Contingencies (35% for well field)				$674,800
Easement - Rural	0	AC	$1,200	$0
Permitting and Mitigation	0	MI	$25,000	$0
Groundwater Rights/ Purchase	600	AC-FT	$500	$300,000
Interest During Construction (6 Months)				$55,000
TOTAL CAPITAL COST				**$3,217,800**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$269,000
Electricity				$30,700
Water Treatment				$12,805
Operation and Maintenance				$60,200
Total Annual Cost				**$372,705**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$621**
Water Cost ($ per 1,000 gallons)				**$1.91**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$173**
Water Cost ($ per 1,000 gallons)				**$0.53**

Table E-15
City of Wellington
Develop Seymour Aquifer Supplies

Owner:	City of Wellington			
Quantity:	180 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (100 GPM)	2	EA	$127,029	$254,000
6" Well Field Collection Lines	5,280	LF	$20	$106,000
Connection to Pump Station	2	EA	$140,000	$280,000
Subtotal for Wellfield and Treatment				**$640,000**
Transmission System				
8" Pipeline - Transmission Main	15,840	LF	$31	$491,000
Pump Station	1	LS	$629,000	$629,000
Subtotal for Transmission				**$1,120,000**
TOTAL CONSTRUCTION COST				**$1,760,000**
Engineering and Contingencies (30% for pipelines)				$203,700
Engineering and Contingencies (35% for well field)				$407,100
Easement - Rural	7	AC	$1,200	$9,000
Permitting and Mitigation	3	MI	$25,000	$75,000
Groundwater Rights/ Purchase	180	AC-FT	$500	$90,000
Interest During Construction (6 Months)				$45,000
TOTAL CAPITAL COST				**$2,589,800**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$217,000
Electricity				$1,700
Water Treatment				$6,417
Operation and Maintenance				$42,100
Total Annual Cost				**$267,217**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$1,485**
Water Cost ($ per 1,000 gallons)				**$4.56**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$279**
Water Cost ($ per 1,000 gallons)				**$0.86**

Table E-16
City of Wellington
Advanced Treatment (Nitrate Removal)

Owner:	City of Wellington			
Quantity:	500 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
0.5 MGD RO Treatment Facility	1	EA	$2,267,000	$2,267,000
Storage Tank (Closed)	1	EA	$412,000	$412,000
Subtotal for Wellfield and Treatment				**$2,679,000**
Transmission System				
Subtotal for Transmission				**$0**
TOTAL CONSTRUCTION COST				**$2,679,000**
Engineering and Contingencies (30% for pipelines)				$0
Engineering and Contingencies (35% for well field)				$937,700
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$63,000
TOTAL CAPITAL COST				**$3,679,700**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$308,000
Electricity				$0
Water Treatment				$194,350
Operation and Maintenance				$12,400
Total Annual Cost				**$514,750**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$1,029**
Water Cost ($ per 1,000 gallons)				**$3.16**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$413**
Water Cost ($ per 1,000 gallons)				**$1.27**

Table E-17
City of Dalhart
Develop Ogallala Aquifer Supplies

Owner:	City of Dalhart			
Quantity:	2,700	AF/Y		
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Rehab Exisitng wells	3	EA	$100,000	$300,000
Water Wells (800 GPM)	1	EA	$552,871	$553,000
Rehab Well Field Collection Pipeline(s)	3	EA	$50,000	$150,000
Connection to Pump Station	1	EA	$140,000	$140,000
Storage Tank (Closed)	1	EA	$412,000	$412,000
Subtotal for Wellfield and Treatment				**$1,255,000**
Transmission System				
24" Pipeline - Transmission Main	10,560	LF	$113	$1,193,000
Pump Station	1	LS	$809,000	$809,000
Subtotal for Transmission				**$2,002,000**
TOTAL CONSTRUCTION COST				**$3,257,000**
Engineering and Contingencies (30% for pipelines)				$87,000
Engineering and Contingencies (35% for well field)				$725,900
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$72,000
TOTAL CAPITAL COST				**$4,197,900**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$351,000
Electricity				$119,000
Water Treatment				$38,177
Operation and Maintenance				$65,700
Total Annual Cost				**$573,877**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$213**
Water Cost ($ per 1,000 gallons)				**$0.65**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$83**
Water Cost ($ per 1,000 gallons)				**$0.25**

Table E-18
City of Texline
Develop Ogallala Aquifer Supplies

Owner:	City of Texline			
Quantity:	150 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (200 GPM)	1	EA	$477,000	$477,000
Well Field Collection Pipeline(s)	1	EA	$100,000	$100,000
Connection to Pump Station	1	EA	$140,000	$140,000
Subtotal for Wellfield and Treatment				**$717,000**
TOTAL CONSTRUCTION COST				**$717,000**
Engineering and Contingencies (30% for pipelines)				$30,000
Engineering and Contingencies (35% for well field)				$216,000
Groundwater Rights/ Purchase	150	AC-FT	$500	$75,000
Interest During Construction (6 Months)				$18,000
TOTAL CAPITAL COST				**$1,056,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$88,000
Electricity				$3,100
Water Treatment				$5,960
Operation and Maintenance				$19,700
Total Annual Cost				**$116,760**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$778**
Water Cost ($ per 1,000 gallons)				**$2.39**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$192**
Water Cost ($ per 1,000 gallons)				**$0.59**

Table E-19
City of McLean
Develop Ogallala Aquifer Supplies

Owner:	City of McLean			
Quantity:	200 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield				
Water Wells (260 GPM)	1	EA	$264,291	$264,000
Well Field Collection Pipeline(s)	1	EA	$100,000	$100,000
Connection to Pump Station	1	EA	$140,000	$140,000
Subtotal for Wellfield				**$504,000**
TOTAL CONSTRUCTION COST				**$504,000**
Engineering and Contingencies (30% for pipelines)				$30,000
Engineering and Contingencies (35% for well field)				$141,400
Groundwater Rights/ Purchase	200	AC-FT	$500	$100,000
Interest During Construction (6 Months)				$14,000
TOTAL CAPITAL COST				**$789,400**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$66,000
Electricity				$3,200
Water Treatment				$6,721
Operation and Maintenance				$13,300
Total Annual Cost				**$89,221**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$446**
Water Cost ($ per 1,000 gallons)				**$1.37**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$116**
Water Cost ($ per 1,000 gallons)				**$0.36**

Table E-20 City of Pampa Develop Ogallala Aquifer Supplies					
Owner:	City of Pampa				
Quantity:	2,000	AF/Y			
Capital Costs	**Quantity**	**Unit**		**Unit Price**	**Cost**
Wellfield and Treatment					
Water Wells (620 GPM)	4		EA	$525,288	$2,101,000
Well Field Collection Pipeline(s)	4		EA	$100,000	$400,000
Connection to Pump Station	4		EA	$140,000	$560,000
Storage Tank (Closed)	1		EA	$412,000	$412,000
Subtotal for Wellfield and Treatment					**$3,473,000**
Transmission System					
18" Pipeline - Transmission Main	15,840	LF		$76	$1,204,000
Pump Station	1	LS		$809,000	$809,000
Subtotal for Transmission					**$2,013,000**
TOTAL CONSTRUCTION COST					**$5,486,000**
Engineering and Contingencies (30% for pipelines)					$541,400
Engineering and Contingencies (35% for well field)					$1,358,700
Easement - Rural	7	AC		$1,200	$9,000
Permitting and Mitigation	3	MI		$25,000	$75,000
Groundwater Rights/ Purchase	2,000	AC-FT		$500	$1,000,000
Interest During Construction (6 Months)					$148,000
TOTAL CAPITAL COST					**$8,618,100**
Annual Costs					
Debt Service (5.5 percent for 20 years)					$721,000
Electricity					$93,500
Water Treatment					$30,442
Operation and Maintenance					$135,700
Total Annual Cost					**$980,642**
UNIT COSTS (Until Amortized)					
Water Cost ($ per ac-ft)					**$490**
Water Cost ($ per 1,000 gallons)					**$1.50**
UNIT COSTS (After Amortization)					
Water Cost ($ per ac-ft)					**$130**
Water Cost ($ per 1,000 gallons)					**$0.40**

Table E-21
City of Memphis
Develop Ogallala Aquifer Supplies

Owner:	City of Memphis			
Quantity:	150 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (150 GPM)	2	EA	$167,000	$334,000
Well Field Collection Pipeline(s)	2	EA	$100,000	$200,000
Connection to Pump Station	2	EA	$140,000	$280,000
Subtotal for Wellfield and Treatment				**$814,000**
TOTAL CONSTRUCTION COST				**$814,000**
Engineering and Contingencies (30% for pipelines)				$60,000
Engineering and Contingencies (35% for well field)				$214,900
Groundwater Rights/ Purchase	150	AC-FT	$500	$75,000
Interest During Construction (6 Months)				$20,000
TOTAL CAPITAL COST				**$1,183,900**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$99,000
Electricity				$1,500
Water Treatment				$5,960
Operation and Maintenance				$20,800
Total Annual Cost				**$127,260**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$848**
Water Cost ($ per 1,000 gallons)				**$2.60**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$188**
Water Cost ($ per 1,000 gallons)				**$0.58**

Table E-22 County Other - Hall County (Brice-Lesly) New Groundwater Source				
Owner:	County Other - Hall County			
Quantity:	50 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (75 GPM)	1	EA	$217,731	$218,000
Subtotal for Wellfield and Treatment				**$218,000**
TOTAL CONSTRUCTION COST				**$218,000**
Engineering and Contingencies (30% for pipelines)				$0
Engineering and Contingencies (35% for well field)				$76,300
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$5,000
TOTAL CAPITAL COST				**$299,300**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$25,000
Electricity				$500
Water Treatment				$2,401
Operation and Maintenance				$6,500
Total Annual Cost				**$34,401**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$688**
Water Cost ($ per 1,000 gallons)				**$2.11**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$188**
Water Cost ($ per 1,000 gallons)				**$0.58**

Table E-23
County Other - Hall County (Estelline)
New Groundwater Source

Owner:	County Other - Hall County			
Quantity:	50 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (75 GPM)	1	EA	$102,700	$103,000
Subtotal for Wellfield and Treatment				**$103,000**
TOTAL CONSTRUCTION COST				**$103,000**
Engineering and Contingencies (30% for pipelines)				$0
Engineering and Contingencies (35% for well field)				$36,100
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$2,000
TOTAL CAPITAL COST				**$141,100**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$12,000
Electricity				$500
Water Treatment				$2,401
Operation and Maintenance				$3,100
Total Annual Cost				**$18,001**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$360**
Water Cost ($ per 1,000 gallons)				**$1.10**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$120**
Water Cost ($ per 1,000 gallons)				**$0.37**

Table E-24
County Other - Hall County (Lakeview)
Advanced Treatment (Nitrate Removal)

Owner:	County Other - Hall County			
Quantity:	75 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
0.1 MGD RO Treatment Facility	1	EA	$972,000	$972,000
Storage Tank (Closed)	1	EA	$193,000	$193,000
Subtotal for Wellfield and Treatment				**$1,165,000**
TOTAL CONSTRUCTION COST				**$1,165,000**
Engineering and Contingencies (30% for pipelines)				$0
Engineering and Contingencies (35% for well field)				$407,800
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$28,000
TOTAL CAPITAL COST				**$1,600,800**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$134,000
Electricity				$0
Water Treatment				$111,057
Operation and Maintenance				$5,800
Total Annual Cost				**$250,857**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$3,345**
Water Cost ($ per 1,000 gallons)				**$10.26**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$1,558**
Water Cost ($ per 1,000 gallons)				**$4.78**

Table E-25
County Other - Hall County (Turkery)
New Groundwater Source

Owner:	County Other - Hall County			
Quantity:	100 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (170 GPM)	2	EA	$264,079	$528,000
Subtotal for Wellfield and Treatment				**$528,000**
Transmission System				
6" Pipeline - Transmission Main	18,480	LF	$20	$370,000
Subtotal for Transmission				**$370,000**
TOTAL CONSTRUCTION COST				**$898,000**
Engineering and Contingencies (30% for pipelines)				$129,500
Engineering and Contingencies (35% for well field)				$184,800
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$23,000
TOTAL CAPITAL COST				**$1,345,300**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$113,000
Electricity				$0
Water Treatment				$4,803
Operation and Maintenance				$20,200
Total Annual Cost				**$138,003**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$1,380**
Water Cost ($ per 1,000 gallons)				**$4.24**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$250**
Water Cost ($ per 1,000 gallons)				**$0.77**

Table E-26
City of Gruver
Develop Ogallala Aquifer Supplies

Owner:	City of Gruver			
Quantity:	350 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (265 GPM)	2	EA	$268,154	$536,000
Well Field Collection Pipeline(s)	2	EA	$100,000	$200,000
Connection to Pump Station	2	EA	$140,000	$280,000
Subtotal for Wellfield and Treatment				**$1,016,000**
TOTAL CONSTRUCTION COST				**$1,016,000**
Engineering and Contingencies (30% for pipelines)				$60,000
Engineering and Contingencies (35% for well field)				$285,600
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$24,000
TOTAL CAPITAL COST				**$1,385,600**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$116,000
Electricity				$5,500
Water Treatment				$9,002
Operation and Maintenance				$26,900
Total Annual Cost				**$157,402**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$450**
Water Cost ($ per 1,000 gallons)				**$1.38**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$118**
Water Cost ($ per 1,000 gallons)				**$0.36**

Table E-27 City of Spearman Develop Ogallala Aquifer Supplies					
Owner:	City of Spearman				
Quantity:	650 AF/Y				
Capital Costs	**Quantity**	**Unit**		**Unit Price**	**Cost**
Wellfield and Treatment					
Water Wells (620 GPM)	2		EA	$527,914	$1,056,000
Well Field Collection Pipeline(s)	2		EA	$100,000	$200,000
Connection to Pump Station	2		EA	$140,000	$280,000
Subtotal for Wellfield and Treatment					**$1,536,000**
Transmission System					
Pump Station	1	LS		$700,000	$700,000
14" Pipeline	5,280	LF		$51	$269,000
Subtotal for Transmission					**$969,000**
TOTAL CONSTRUCTION COST					**$2,505,000**
Engineering and Contingencies (30% for pipelines)					$60,000
Engineering and Contingencies (35% for well field)					$712,600
Groundwater Rights/ Purchase	650 AC-FT			$500	$325,000
Interest During Construction (6 Months)					$63,000
TOTAL CAPITAL COST					**$3,665,600**
Annual Costs					
Debt Service (5.5 percent for 20 years)					$307,000
Electricity					$29,600
Water Treatment					$13,565
Operation and Maintenance					$63,500
Total Annual Cost					**$413,665**
UNIT COSTS (Until Amortized)					
Water Cost ($ per ac-ft)					**$636**
Water Cost ($ per 1,000 gallons)					**$1.95**
UNIT COSTS (After Amortization)					
Water Cost ($ per ac-ft)					**$164**
Water Cost ($ per 1,000 gallons)					**$0.50**

Table E-28 City of Stinnett Develop Ogallala Aquifer Supplies				
Owner:	City of Stinnett			
Quantity:	225 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (625 GPM)	1	EA	$436,658	$437,000
Well Field Collection Pipeline(s)	0	EA	$100,000	$0
Connection to Pump Station	1	EA	$140,000	$140,000
Subtotal for Wellfield and Treatment				**$577,000**
TOTAL CONSTRUCTION COST				**$577,000**
Engineering and Contingencies (30% for pipelines)				$0
Engineering and Contingencies (35% for well field)				$202,000
Groundwater Rights/ Purchase	225	AC-FT	$500	$113,000
Interest During Construction (6 Months)				$16,000
TOTAL CAPITAL COST				**$908,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$76,000
Electricity				$6,900
Water Treatment				$7,101
Operation and Maintenance				$17,300
Total Annual Cost				**$107,301**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$477**
Water Cost ($ per 1,000 gallons)				**$1.46**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$139**
Water Cost ($ per 1,000 gallons)				**$0.43**

Table E-29 TCW Supply Inc. Develop Ogallala Aquifer Supplies				
Owner:	TCW Supply Inc.			
Quantity:	575 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (360 GPM)	2	EA	$480,899	$962,000
Well Field Collection Pipeline(s)	2	EA	$100,000	$200,000
Connection to Pump Station	2	EA	$140,000	$280,000
Storage Tank (Closed)	1	EA	$193,000	$193,000
Subtotal for Wellfield and Treatment				**$1,635,000**
Transmission System				
Pump Station	1	LS	$694,000	$694,000
12" Pipeline - Transmission Main	10,560	LF	$38	$401,000
Subtotal for Transmission				**$1,095,000**
TOTAL CONSTRUCTION COST				**$2,730,000**
Engineering and Contingencies (30% for pipelines)				$60,000
Engineering and Contingencies (35% for well field)				$745,200
Groundwater Rights/ Purchase	575 AC-FT		$500	$288,000
Interest During Construction (6 Months)				$67,000
TOTAL CAPITAL COST				**$3,890,200**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$326,000
Electricity				$18,200
Water Treatment				$12,425
Operation and Maintenance				$66,300
Total Annual Cost				**$422,925**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$736**
Water Cost ($ per 1,000 gallons)				**$2.26**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$169**
Water Cost ($ per 1,000 gallons)				**$0.52**

Table E-30
City of Booker
Develop Ogallala Aquifer Supplies

Owner:	City of Booker			
Quantity:	700 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (620 GPM)	2	EA	$341,916	$684,000
Well Field Collection Pipeline(s)	2	EA	$100,000	$200,000
Connection to Pump Station	0	EA	$140,000	$0
Subtotal for Wellfield and Treatment				**$884,000**
TOTAL CONSTRUCTION COST				**$884,000**
Engineering and Contingencies (30% for pipelines)				$60,000
Engineering and Contingencies (35% for well field)				$239,400
Groundwater Rights/ Purchase	700	AC-FT	$500	$350,000
Interest During Construction (6 Months)				$27,000
TOTAL CAPITAL COST				**$1,560,400**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$131,000
Electricity				$20,900
Water Treatment				$14,326
Operation and Maintenance				$22,900
Total Annual Cost				**$189,126**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$270**
Water Cost ($ per 1,000 gallons)				**$0.83**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$83**
Water Cost ($ per 1,000 gallons)				**$0.25**

Table E-31 City of Dumas Develop Ogallala Aquifer Supplies				
Owner:	City of Dumas			
Quantity:	4,500 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (690 GPM)	9	EA	$496,046	$4,464,000
Well Field Collection Pipeline(s)	9	EA	$100,000	$900,000
Connection to Pump Station	9	EA	$140,000	$1,260,000
Subtotal for Wellfield and Treatment				**$6,624,000**
Transmission System				
Pump Station	1	LS	$875,000	$875,000
Subtotal for Transmission				**$875,000**
TOTAL CONSTRUCTION COST				**$7,499,000**
Engineering and Contingencies (30% for pipelines)				$270,000
Engineering and Contingencies (35% for well field)				$2,309,700
Groundwater Rights/ Purchase	4,500	AC-FT	$500	$2,250,000
Interest During Construction (6 Months)				$216,000
TOTAL CAPITAL COST				**$12,544,700**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$1,050,000
Electricity				$175,900
Water Treatment				$58,066
Operation and Maintenance				$208,800
Total Annual Cost				**$1,492,766**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$332**
Water Cost ($ per 1,000 gallons)				**$1.02**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$98**
Water Cost ($ per 1,000 gallons)				**$0.30**

Table E-32
City of Sunray
Develop Ogallala Aquifer Supplies

Owner:	City of Sunray			
Quantity:	850 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (470 GPM)	3	EA	$422,867	$1,269,000
8" Well Field Piping	10,560	LF	$31	$327,000
Connection to Pump Station	3	EA	$140,000	$420,000
Storage Tank (Closed)	1	EA	$248,000	$248,000
Subtotal for Wellfield and Treatment				**$2,264,000**
TOTAL CONSTRUCTION COST				**$2,264,000**
Engineering and Contingencies (30% for pipelines)				$98,100
Engineering and Contingencies (35% for well field)				$678,000
Groundwater Rights/ Purchase	850	AC-FT	$500	$425,000
Interest During Construction (6 Months)				$61,000
TOTAL CAPITAL COST				**$3,526,100**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$295,000
Electricity				$28,900
Water Treatment				$16,607
Operation and Maintenance				$62,000
Total Annual Cost				**$402,507**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$474**
Water Cost ($ per 1,000 gallons)				**$1.45**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$126**
Water Cost ($ per 1,000 gallons)				**$0.39**

Table E-33 Manufacturing - Moore County New Groundwater Source				
Owner:	Manufacturing - Moore County			
Quantity:	4,000 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (450 GPM)	15	EA	$422,000	$6,330,000
Connection to User	15	EA	$25,000	$375,000
Subtotal for Wellfield and Treatment				**$6,705,000**
TOTAL CONSTRUCTION COST				**$6,705,000**
Engineering and Contingencies (30% for pipelines)				$0
Engineering and Contingencies (35% for well field)				$2,346,800
Groundwater Rights/ Purchase	4,000	AC-FT	$500	$2,000,000
Interest During Construction (6 Months)				$193,000
TOTAL CAPITAL COST				**$11,244,800**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$941,000
Electricity				$132,300
Water Treatment				$52,542
Operation and Maintenance				$201,200
Total Annual Cost				**$1,327,042**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$332**
Water Cost ($ per 1,000 gallons)				**$1.02**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$97**
Water Cost ($ per 1,000 gallons)				**$0.30**

Table E-34 City of Perryton Develop Ogallala Aquifer Supplies				
Owner:	City of Perryton			
Quantity:	2,800 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (490 GPM)	8	EA	$492,647	$3,941,000
Well Field Collection Pipeline(s)	8	EA	$100,000	$800,000
Connection to Pump Station	4	EA	$140,000	$560,000
Subtotal for Wellfield and Treatment				**$5,301,000**
Transmission System				
Pump Station	1	LS	$802,000	$802,000
Pipeline	10,560	LF	$76	$803,000
Subtotal for Transmission				**$1,605,000**
TOTAL CONSTRUCTION COST				**$6,906,000**
Engineering and Contingencies (30% for pipelines)				$240,000
Engineering and Contingencies (35% for well field)				$1,856,100
Groundwater Rights/ Purchase	2,800	AC-FT	$500	$1,400,000
Interest During Construction (6 Months)				$182,000
TOTAL CAPITAL COST				**$10,584,100**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$886,000
Electricity				$96,200
Water Treatment				$39,282
Operation and Maintenance				$168,700
Total Annual Cost				**$1,190,182**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$425**
Water Cost ($ per 1,000 gallons)				**$1.30**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$109**
Water Cost ($ per 1,000 gallons)				**$0.33**

Table E-35
County Other - Potter County
Develop Ogallala Aquifer Supplies

Owner: Potter County-Other
Quantity: 900 AF/Y

Capital Costs	Quantity	Unit	Unit Price	Cost
Wellfield and Treatment				
Water Wells (70 GPM)	15	EA	$122,642	$1,840,000
Subtotal for Wellfield and Treatment				**$1,840,000**
Transmission System				
Pump Station	1	LS	$724,000	$724,000
Subtotal for Transmission				**$724,000**
TOTAL CONSTRUCTION COST				**$2,564,000**
Engineering and Contingencies (30% for pipelines)				$0
Engineering and Contingencies (35% for well field)				$897,400
Groundwater Rights/ Purchase	900	AC-FT	$500	$450,000
Interest During Construction (6 Months)				$68,000
TOTAL CAPITAL COST				**$3,979,400**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$333,000
Electricity				$11,700
Water Treatment				$17,368
Operation and Maintenance				$76,900
Total Annual Cost				**$438,968**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$488**
Water Cost ($ per 1,000 gallons)				**$1.50**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$118**
Water Cost ($ per 1,000 gallons)				**$0.36**

Table E-36
County Other - Potter County
Develop Dockum Aquifer Supplies

Owner:	Potter County-Other			
Quantity:	700 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (70 GPM)	12	EA	$122,642	$1,472,000
Subtotal for Wellfield and Treatment				**$1,472,000**
Transmission System				
Pump Station	1	LS	$704,000	$704,000
Subtotal for Transmission				**$704,000**
TOTAL CONSTRUCTION COST				**$2,176,000**
Engineering and Contingencies (30% for pipelines)				$0
Engineering and Contingencies (35% for well field)				$761,600
Groundwater Rights/ Purchase	700	AC-FT	$500	$350,000
Interest During Construction (6 Months)				$58,000
TOTAL CAPITAL COST				**$3,345,600**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$280,000
Electricity				$9,100
Water Treatment				$14,326
Operation and Maintenance				$65,300
Total Annual Cost				**$368,726**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$527**
Water Cost ($ per 1,000 gallons)				**$1.62**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$127**
Water Cost ($ per 1,000 gallons)				**$0.39**

Table E-37
Manufacturing Potter County
Direct Reuse

Owner:	Manufacturing Potter County			
Quantity:	5,700 AF/Y			
Capital Costs	**Quantity**	**Units**	**Unit Price**	**Cost**
18- inch pipeline	52,800	LF	$107	$5,625,000
6.5 MGD Pre-Treatment WTP	1	EA	$9,916,000	$9,916,000
6.5 MGD RO Plant	1	EA	$17,571,000	$17,571,000
Wastewater Treatment Plant Improvements	1	LS	$2,500,000	$2,500,000
Pump Station at WWTP	1	LS	$1,500,000	$1,500,000
12 inch RO Discharge Line	36,960	LF	$54	$1,978,000
TOTAL CONSTRUCTION COST				**$39,090,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering, Legal Costs and Contingencies (30% pipelines)				$2,280,900
Engineering, Legal Costs and Contingencies (35% all other)				$10,495,450
Land Acquisition	206	Ac	$10,000	$2,061,000
Permitting and Mitigation	17 mi		$25,000	$925,000
Interest During Construction (18 months)				$2,880,000
TOTAL CAPITAL COST				**$57,732,350**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$4,831,000
Operation and Maintenance				$139,000
Treatment O&M				$2,167,145
Pumping Energy Costs ($0.09/kWh)				$340,000
Total Annual Cost				**$7,477,145**
UNIT COST (Until Amortized)				
Annual Cost of Water ($ per acft)				$1,312
Annual Cost of Water ($ per 1,000 gallons)				$4.03
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				$464
Water Cost ($ per 1,000 gallons)				$1.42

Table E-38
City of Canyon
Drill Nine Wells (Dockum Aquifer)

Owner:	City of Canyon			
Quantity:	4,300 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Mobilization	1	LS	$335,000	$335,000
Wells	9	Ea.	$447,000	$4,023,000
Subtotal for Wellfield and Treatment				**$4,358,000**
Transmission System				
PVC C905 Pipe	15,000	LF	$112	$1,680,000
PVC C900 Pipe	21,300	LF	$56	$1,192,800
GV & B	4	EA	$22,000	$88,000
GV & B	10	EA	$5,600	$56,000
Bore Under Railroad	340	LF	$391	$132,900
Casing thru Bore	340	LF	$223	$75,800
Ground Stoarage Tank	1	EA	$1,116,000	$1,116,000
Controls	1	EA	$56,000	$56,000
Fittings	20,000	LBS	$6	$120,000
Electrical Service	1	LS	$111,628	$111,600
Subtotal for Transmission				**$4,629,100**
TOTAL CONSTRUCTION COST				**$8,987,100**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Contingencies (10%)				$899,000
Engineering (11%)				$989,000
Enginnering Survey (1%)				$99,000
Testing (0.55%)				$49,000
Project Representation (2.2%)				$198,000
Interest During Construction (1 year)				$393,000
TOTAL CAPITAL COST				**$11,614,100**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$1,012,600
Electricity				$202,700
Water Treatment ($0.30 per 1,000 gal)				$420,300
Operation and Maintenance				$191,200
Total Annual Cost				**$1,826,800**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$425**
Water Cost ($ per 1,000 gallons)				**$1.30**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$189**
Water Cost ($ per 1,000 gallons)				**$0.58**

Table E-39
Lake Tanglewood
Develop Ogallala Aquifer Supplies

Owner:	Lake Tanglewood	
Quantity:	300	AF/Y

Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (200 GPM)	2	EA	$238,000	$476,000
Well Field Collection Pipeline(s)	2	EA	$100,000	$200,000
Connection to Pump Station	1	EA	$140,000	$140,000
Subtotal for Wellfield and Treatment				**$816,000**
Transmission System				
8" Pipeline - Transmission Main	15,840	LF	$31	$491,000
Pump Station	1	LS	$694,000	$694,000
Subtotal for Transmission				**$1,185,000**
TOTAL CONSTRUCTION COST				**$2,001,000**
Engineering and Contingencies (30% for pipelines)				$231,900
Engineering and Contingencies (35% for well field)				$458,500
Easement - Rural	7	AC	$1,200	$9,000
Permitting and Mitigation	3	MI	$25,000	$75,000
Groundwater Rights/ Purchase	300	AC-FT	$500	$150,000
Interest During Construction (6 Months)				$51,000
TOTAL CAPITAL COST				**$2,976,400**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$249,000
Electricity				$5,800
Water Treatment				$8,242
Operation and Maintenance				$47,600
Total Annual Cost				**$310,642**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$1,035**
Water Cost ($ per 1,000 gallons)				**$3.18**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$205**
Water Cost ($ per 1,000 gallons)				**$0.63**

Table E-40
County Other - Randall County
Develop Ogallala Aquifer Supplies

Owner:	Randall County-Other			
Quantity:	2,800 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (490 GPM)	8	EA	$482,192	$3,858,000
Subtotal for Wellfield and Treatment				**$3,858,000**
TOTAL CONSTRUCTION COST				**$3,858,000**
Engineering and Contingencies (35% for wells)				$1,350,300
Interest During Construction (6 Months)				$91,000
TOTAL CAPITAL COST				**$5,299,300**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$443,000
Electricity				$96,600
Water Treatment				$39,282
Operation and Maintenance				$115,700
Total Annual Cost				**$694,582**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$248**
Water Cost ($ per 1,000 gallons)				**$0.76**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$90**
Water Cost ($ per 1,000 gallons)				**$0.28**

Table E-41
Manufacturing - Randall County
Develop Ogallala Aquifer Supplies

Owner:	Randall County Manufacturing			
Quantity:	300 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (150 GPM)	2	EA	$271,707	$543,000
Subtotal for Wellfield and Treatment				**$543,000**
TOTAL CONSTRUCTION COST				**$543,000**
Engineering and Contingencies (35% for wells)				$190,000
Interest During Construction (6 Months)				$13,000
TOTAL CAPITAL COST				**$746,000**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$62,000
Electricity				$11,900
Operation and Maintenance				$16,300
Total Annual Cost				**$90,200**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$301**
Water Cost ($ per 1,000 gallons)				**$0.92**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$94**
Water Cost ($ per 1,000 gallons)				**$0.29**

Table E-42 City of Wheeler Develop Ogallala Aquifer Supplies				
Owner:	City of Wheeler			
Quantity:	500 AF/Y			
Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Cost**
Wellfield and Treatment				
Water Wells (400 GPM)	2	EA	$283,529	$567,000
8" Well Field Piping	2,000	LF	$31	$62,000
Connection to Pump Station	2	EA	$140,000	$280,000
Subtotal for Wellfield and Treatment				**$909,000**
Transmission System				
8" Pipeline - Transmission Main	10,560	LF	$31	$327,000
Pump Station	1	LS	$760,000	$760,000
Subtotal for Transmission				**$1,087,000**
TOTAL CONSTRUCTION COST				**$1,996,000**
Other Project Cost:	**Quantity**	**Units**	**Unit Price**	**Cost**
Engineering and Contingencies (30% for pipelines)				$133,100
Engineering and Contingencies (35% for well field)				$562,500
Easement - Rural	5	AC	$1,200	$6,000
Permitting and Mitigation	2	MI	$25,000	$50,000
Groundwater Rights/ Purchase	0	AC-FT	$500	$0
Interest During Construction (6 Months)				$48,000
TOTAL CAPITAL COST				**$2,795,600**
Annual Costs				
Debt Service (5.5 percent for 20 years)				$234,000
Electricity				$14,300
Water Treatment				$11,284
Operation and Maintenance				$52,900
Total Annual Cost				**$312,484**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$625**
Water Cost ($ per 1,000 gallons)				**$1.92**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$157**
Water Cost ($ per 1,000 gallons)				**$0.48**

Appendix F

Consistency Matrix

CHECKLIST FOR COMPARISON OF THE REGIONAL WATER PLAN TO APPLICABLE WATER PLANNING REGULATIONS

The purpose of this attachment is to facilitate the determination of how the Regional Water Plan is consistent with the long-term protection of the water, agricultural, and natural resources of the State of Texas, particularly within this region. The following checklist includes a regulatory citation (Column 1) for all subsections and paragraphs contained in the following applicable portions of the water planning regulations:

- 31 TAC Chapter 358.3
- 31 TAC Chapter 357.3
- 31 TAC Chapter 357.4
- 31 TAC Chapter 357.2
- 31 TAC Chapter 357.5

According to 31 TAC Chapter 357.41, the Regional Water Plan is considered to be consistent with the long-term protection of the State's resources if complies with the above listed requirements. Therefore, the Regional Water Plan has been compared to each applicable section of the regulations as a means of determining consistency.

The checklist also includes a summary description of each cited regulation (Column 2). It should be understood that this summary is intended only to provide a general description of the particular section of the regulation and should not be assumed to contain all specifics of the actual regulation. The evaluation of the Regional Water Plan should be performed against the complete regulation, as contained in the actual 31 TAC 358 and 31 TAC 357 regulations.

Column 3 of the checklist provides the evaluation response as affirmative, negative, or not applicable. A "Yes" in this column indicates that the Regional Water Plan has been evaluated to comply with the stated section of the regulation. A "No" response indicates that the Regional Water Plan does not comply with the stated regulation. A response of "NA" (or not applicable) indicates that the stated section of the regulation does not apply to this Regional Water Plan.

The evidence of where, in the Regional Water Plan, the stated regulation is addressed is provided in Column 4. Where the regulation is addressed in multiple locations within the Regional Water Plan, this column may cite only the primary locations. In addition to identifying where the regulation is addressed, this column may include commentary about the application of the regulation in the Regional Water Plan.

The above-listed regulations are repetitive, in some instances. One section of the regulations may be restated or paraphrased elsewhere within the regulations. In some cases, multiple sections of the regulations may be combined into one separate regulation section. Therefore, Column 5 provides cross-referencing.

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
Guidance Principles				
31 TAC §358.3				
358.3 (1)	The state water plan shall provide for the preparation for and response to drought conditions.	Yes	Chapters 1, 2, 3, 5, 7	
(2)	The RWP and SWP shall serve as water supply plans under drought of record conditions.	Yes	See above	
(3)	Consideration shall be given to the construction and improvement of surface water resources and the application of principles that result in voluntary redistribution of water resources.	Yes	Chapter 5	
(4)	Provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions so that sufficient water will be available at a reasonable cost to satisfy a reasonable projected use of water to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of the regional water planning area.	Yes	Chapters 5, 6	
(5)	Include identification of those policies and action that may be needed to meet Texas' water supply needs and prepare for and respond to drought conditions.	Yes	Chapters 5 and 7	
(6)	Decision-making shall be open to and accountable to the public with decisions based on accurate, objective and reliable information with full dissemination of planning results except for those matters made confidential by law.	Yes	Chapter 10	
(7)	Establish terms of participation in water planning efforts that shall be equitable and shall not unduly hinder participation.	Yes	Chapter 10	
(8)	Consideration of the effect of policies or water management strategies on the public interest of the state, water supply, and those entities involved in providing this supply throughout the entire state.	Yes	Chapter 8	
(9)	Consideration of all water management strategies the regional water plan determines to be potentially feasible when developing plans to meet future water needs and to respond to drought so that cost effective water management strategies which are consistent with long-term protection of the state's water resources, agricultural resources, and natural resources are considered and approved.	Yes	Chapters 5 and 6	
(10)	Consideration of opportunities that encourage and result in voluntary transfers of water resources, including but not limited to regional water banks, sales, leases, options, subordination agreements, and financing agreements.	Yes	Chapter 5	
(11)	Consideration of a balance of economic, social, aesthetic, and ecological viability.	Yes	Chapter 5	
(12)	For regional water planning areas without approved regional water plans or water providers for which revised plans are not developed through the regional water planning process, the use of information from the adopted state water plan and other completed studies that are sufficient for water planning shall represent the water supply plan for that area or water provider.	NA		
(13)	All surface waters are held in trust by the state, their use is subject to rights granted and administered by the Commission, and the use of surface water is governed by the prior appropriation doctrine, unless adjudicated otherwise.	Yes	Chapter 3	
(14)	Existing water rights, water contracts, and option agreements shall be protected. However, potential amendments of water rights, contracts and agreements may be considered and evaluated. Any amendments will require the eventual consent of the owner.	Yes	Chapters 3 and 5	
(15)	The production and use of groundwater in Texas is governed by the rule of capture doctrine unless and to the extent that such production and use is regulated by a groundwater conservation district.	Yes	Chapter 3	§36.002
(16)	Consideration of recommendations of river and stream segments of unique ecological value to the legislature for potential protection.	Yes	Chapter 8	
(17)	Consideration of recommendation of sites of unique value for the construction of reservoirs to the legislature for potential protection.	Yes	Chapter 8	
(18)	Consideration of water planning and management activities of local, regional, state, and federal agencies, along with existing local, regional, and state water plans and information and existing state and federal programs and goals.	Yes	Chapters 1 and 5	
(19)	Designated water quality and related water uses as shown in the state water quality management plan shall be improved or maintained.	Yes	Chapter 6	

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
(20)	Coordination of water planning and management activities of RWPGs to identify common needs and issues and achieve efficient use of water supplies, including the Board and other relevant RWPGs, working together to identify common needs, issues, and challenges while working together to resolve conflicts in a fair, equitable, and efficient manner.	Yes	Entire RWP	
(21)	The water management strategies identified in approved RWPs to meet needs shall be described in sufficient detail to allow a state agency making a financial or regulatory decision to determine if a proposed action before the state agency is consistent with an approved RWP.	Yes	Chapter 5, Appendix E	
(22)	The evaluation of water management strategies shall use environmental information in accordance with the Commission's adopted environmental flow standards where applicable or, in basins where standards are not available or have not been adopted, information from existing site-specific studies or state consensus environmental planning criteria.	NA	No new appropriations are recommended.	30 TAC Chapter 298
(23)	Consideration of environmental water needs including instream flows and bay and estuary inflows, including adjustments by the RWPGs to water management strategies to provide for environmental water needs including instream flows and bay and estuary needs. Consideration shall be consistent with the Commission's adopted environmental flow standards in basins where standards have been adopted.	NA	No new appropriations are recommended. Existing instream regulations considered.	30 TAC Chapter 298
(24)	Planning shall be consistent with all laws applicable to water use for the state and regional water planning area.	Yes	Entire RWP	
(25)	The inclusion of ongoing water development projects that have been permitted by the Commission or a predecessor agency.	NA	None in PWPA	
(26)	Specific recommendations of water management strategies shall be based upon identification, analysis, and comparison of all water management strategies the RWPG determines to be potentially feasible so that the cost effective water management strategies which are environmentally sensitive are considered and adopted unless the RWPG demonstrates that adoption of such strategies is not appropriate.	Yes	Chapter 5	§357.34(d)(3)(A) §357.34(d)(3)(B)
(27)	Achieve efficient use of existing water supplies, explore opportunities for and the benefits of developing regional water supply facilities or providing regional management of water facilities, coordinate the actions of local and regional water resource management agencies, provide substantial involvement by the public in the decision-making process, and provide full dissemination of planning results.	Yes	Chapters 5 and 10	
(28)	Consideration of existing regional water planning efforts when developing RWPs.	Yes	Chapters 1 and 5	
Chapter One Description of the Regional Water Planning Area				
31 TAC §357.30				
	RWPGs shall describe their regional water planning area including the following:			
357.3 (1)	Social and economic aspects of a region such as information on current population, economic activity and economic sectors heavily dependent on water resources	Yes	1.3	
(2)	Current water use and major water demand centers	Yes	1.6	
(3)	Current groundwater, surface water, and reuse supplies including major springs that are important for water supply or protection of natural resources	Yes	1.5	
(4)	Wholesale water providers	Yes	1.4	
(5)	Agricultural and natural resources	Yes	1.7	
(6)	Identified water quality problems	Yes	1.5, 1.7 and 1.8	
(7)	Identified threats to agricultural and natural resources due to water quantity problems or water quality problems related to water supply	Yes	1.8 and 1.9	
(8)	Summary of existing local and regional water plans	Yes	1.1	
(9)	The identified historic drought(s) of record within the planning area	Yes	1.8.2 and Chapter 7	
(10)	Current preparations for drought within the RWPA	Yes	1.8.3, Chapter 7, and http://www.panhandlewater.org/	
(11)	Information compiled by the Board from water loss audits	Yes	1.8.1	§358.6
(12)	An identification of each threat to agricultural and natural resources and a discussion of how that threat will be addressed or affected by the water management strategies evaluated in the plan.		1.8 and Chapter 6	

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
Chapter Two Projected Non-Municipal, Municipal and Population Water Demands				
31 TAC §357.31				
357.31 (a)	Present projected population and water demands by WUG.	Yes	2.2, 2.3, Attachment 2-1	§357.10
(b)	Present projected water demands associated with WWPs by category of water use, including municipal, manufacturing, irrigation, steam electric power generation, mining, and livestock for each county or portion of a county in the RWPA.	Yes	2.7	
(c)	Report the current contractual obligations of WUG and WWPs to supply water in addition to any demands projected for the WUG or WWP.	Yes	2.7	§357.32
(d)	Municipal demands shall be adjusted to reflect water savings due to plumbing fixture requirements identified in the Texas Health and Safety Code, Chapter 372.	Yes	2.4 and Attachment 2-1	Texas Health and Safety Code, Chapter 372
(e)	In developing RWPs, RWPGs shall use:			
(e) (1)	Population and water demand projections developed by the EA that will be contained in the next state water plan and adopted by the Board after consultation with the RWPGs, Commission, Texas Department of Agriculture, and the Texas Parks and Wildlife Department.	Yes	2.2, 2.3, 2.4, 2.5, 2.6	
(e) (2)	RWPGs may request revisions of Board adopted population or water demand projections if the request demonstrates that population or water demand projections no longer represents a reasonable estimate of anticipated conditions based on changed conditions and or new information.	Yes	2.2-Adjustments to population projections were made to eight municipal water user groups. Water demand adjustments were made to municipal water user group based on baseline GPCD errors and alternative dry year. Agricultural demand users were changed based on the Texas A&M AgriLife Memorandum included as Appendix B	§357.21(c)
(f)	Population and water demand projections shall be presented for each planning decade for each of the above reporting categories.	Yes	2.2, 2.3, 2.4, 2.5, 2.6	
Chapter Three Water Supply Analysis				
31 TAC §357.32				
357.32 (a)	RWPGs shall evaluate:			
(a) (1)	Source water availability during drought of record conditions.	Yes	Chapter 3	
(a) (2)	Existing water supplies that are legally and physically available to WUGs and wholesale water suppliers within the RWPA for use during the drought of record.	Yes	3.1, 3.2	
(b)	Consider surface water and groundwater data from the state water plan, existing water rights, contracts and option agreements relating to water rights, other planning and water supply studies, and analysis of water supplies existing in and available to the RWPA during drought of record conditions	Yes	3.1, 3.2	
(c)	Evaluation of the existing surface water available during drought of record shall be based on firm yield. The analysis may be based on justified operational procedures other than firm yield.	Yes	3.1.3	
(d)	Use modeled available groundwater volumes for groundwater availability, as issued by the Board, and incorporate such information in its RWP unless no modeled available groundwater volumes are provided.	Yes	3.1.2	
(e)	Evaluate the existing water supplies for each WUG and WWP	Yes	3.2	
(f)	Water supplies based on contracted agreements will be based on the terms of the contract, which may be assumed to renew upon contract termination if the contract contemplates renewal or extensions.	Yes	3.5, 3.6	
(g)	Evaluation results shall be reported by WUG in accordance with §357.31(a) of this title (relating to Projected Population and Water Demands) and WWPs in accordance with §357.31(b) of this title	Yes	2.7, Chapter 3	§357.31(a) §357.31(b)
Chapter Four Identification of Water Needs				
31 TAC §357.33				
357.33 (a)	Include comparisons of existing water supplies and projected water demands to identify water needs.	Yes	4.2	
(b)	Compare projected water demands with existing water supplies available to WUGs and WWPs in a planning area to determine whether WUGs will experience water surpluses or needs for additional supplies. Results will be reported for WUGs and for WWPs by categories of use including municipal, manufacturing, irrigation, steam electric, mining, and livestock watering for each county or portion of a county in a RWPA.	Yes	4.2, and Attachment 4-1	§357.31 §357.32
(c)	The social and economic impacts of not meeting water needs will be evaluated by RWPGs and reported for each RWPA.	Yes	Chapter 6 and Appendix G	
(d)	Results of evaluations will be reported by WUG in accordance with §357.31(a) of this title and WWPs in accordance with §357.31(b) of this title.	Yes	Attachment 4-1	§357.31(a) §357.31(b)
(e)	Perform a secondary water needs analysis for all WUGs and WWPs for which conservation water management strategies or direct reuse water management strategies are recommended. This secondary water needs analysis will calculate the water needs that would remain after assuming all recommended conservation and direct reuse water management strategies are fully implemented. The resulting secondary water needs volumes shall be presented in the RWP by WUG and WWP and decade.	Yes	4.3 and data table reports in Appendix K	

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
Chapter Five Identification and Evaluation of Potentially Feasible Water Management Strategies				
31 TAC §357.34				
357.34 (a)	Identify and evaluate potentially feasible water management strategies for all WUGs and WWPs with identified water needs.	Yes	Chapter 5	
(b)	Identify potentially feasible water management strategies to meet water supply needs. Strategies shall be developed for WUGs and WWPs. The strategies shall meet new water supply obligations necessary to implement recommended water management strategies of WWPs and WUGs.	Yes	Subchapter 5A	§357.33 §357.12(b)
(c)	Potential Feasible Water Management Strategies should include, but are not limited to:			
(c) (1)	Expanded use of existing supplies including system optimization and conjunctive use of water resources, reallocation of reservoir storage to new uses, voluntary redistribution of water resources including contracts, water marketing, regional water banks, sales, leases, options, subordination agreements, and financing agreements, subordination of existing water rights through voluntary agreements, enhancements of yields of existing sources, and improvement of water quality including control of naturally occurring chlorides.	Yes	Subchapters 5A.1.3, Reallocation of reservoir storage is extremely limited in PWPA. Due to limited supply, this strategy was not considered for PWPA.	
(c) (2)	New supply development including construction and improvement of surface water and groundwater resources, brush control, precipitation enhancement, desalination, water supply that could be made available by cancellation of water rights based on data provided by the Commission, rainwater harvesting, and aquifer storage and recovery.	Yes	Subchapters 5A.1.4 (Groundwater), 5A.1.5 (Brush Control), 5A.1.6 (Precipitation Enhancement) - PWPG did not consider water right cancellation to be a feasible strategy for PWPA.	
(c) (3)	Conservation and drought management measures including demand management.	Yes	Subchapters 5A.1.1, 5B and Chapter 7	
(c) (4)	Reuse of wastewater.	Yes	Subchapter 5A.1.2	
(c) (5)	Interbasin transfers of surface water.	NA	There are no new interbasin strategies for PWPA	
(c) (6)	Emergency transfers of surface water including a determination of the part of each water right for non-municipal use in the RWPA that may be transferred without causing unreasonable damage to the property of the non-municipal water rights holder in accordance with Texas Water Code §11.139 (relating to Emergency Authorizations).	Yes	Chapter 7	§11.139
(d)	Evaluations of Potentially Feasible Water Management Strategies should include the following analyses:			
(d) (1)	For the purpose of evaluating potentially feasible water management strategies, the Commission's most current Water Availability Model with assumptions of no return flows and full utilization of senior water rights, is to be used. Alternative assumptions may be used with written approval from the EA.	Yes	There are no proposed new appropriations of surface water for PWPA.	
(d) (2)	An equitable comparison between and consistent evaluation and application of all water management strategies the RWPGs determine to be potentially feasible for each water supply need.	Yes	Subchapter 5C, 5D and Attachment 5-2	
(d) (3) (A)	A quantitative reporting of the net quantity, reliability, and cost of water delivered and treated for the end user's requirements during drought of record conditions, taking into account and reporting anticipated strategy water losses, incorporating factors used calculating infrastructure debt payments and may include present costs and discounted present value costs. Costs do not include distribution of water within a WUG after treatment.	Yes	Subchapters 5B, 5C, 5D, Attachments 5-2 and 5-3	
(d) (3) (B)	A quantitative reporting of the environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effect of upstream development on bays, estuaries, and arms of the Gulf of Mexico.	Yes	Attachment 5-3	30 TAC Chapter 298
(d) (3) (C)	A quantitative reporting of the impacts to agricultural resources.	Yes	Attachment 5-3	
(d) (4)	Discussion of the plan's impact on other water resources of the state including other water management strategies and groundwater and surface water interrelationships.	Yes	Chapter 6 and Attachment 5-3	
(d) (5)	Discussion of each threat to agricultural or natural resources identified pursuant to §357.30(7) of this title (relating to Description of the Regional Water Planning Area) including how that threat will be addressed or affected by the water management strategies evaluated	Yes	Chapter 6 and Attachment 5-3	§357.30(7)
(d) (6)	If applicable, consideration and discussion of the provisions in Texas Water Code §11.085(k)(1) for interbasin transfers of surface water. At minimum, this consideration will include a summation of water needs in the basin of origin and in the receiving basin.	NA	There are no new interbasin strategies for PWPA.	§11.085(k)(1)
(d) (7)	Consideration of third-party social and economic impacts resulting from voluntary redistributions of water including analysis of third-party impacts of moving water from rural and agricultural areas.	Yes	Chapter 6	
(d) (8)	A description of the major impacts of recommended water management strategies on key parameters of water quality identified by RWPGs as important to the use of a water resource and comparing conditions with the recommended water management strategies to current conditions using best available data.	Yes	Chapter 6	
(d) (9)	Consideration of water pipelines and other facilities that are currently used for water conveyance as described in §357.22(a)(3) of this title (relating to General Considerations for Development of Regional Water Plans).	Yes	Chapter 1 and Subchapter 5B.1	§357.22(a)(3)
(d) (10)	Other factors as deemed relevant by the RWPG including recreational impacts.	Yes	Attachment 5-3	
(e)	Evaluate and present potentially feasible water management strategies with sufficient specificity to allow state agencies to make financial or regulatory decisions to determine consistency of the proposed action before the state agency with an approved RWP.	Yes	Chapter 5	

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
(f)	Conservation, Drought Management Measures, and Drought Contingency Plans shall be considered by RWPGs when developing the regional plans, particularly during the process of identifying, evaluating, and recommending water management strategies. RWPs shall incorporate water conservation planning and drought contingency planning in the regional water planning area.	Yes	Chapter 5 and 7	
(f) (1)	Drought management measures including water demand management. RWPGs shall consider drought management measures for each need identified in §357.33 of this title and shall include such measures for each user group to which Texas Water Code §11.1272 (relating to Drought Contingency Plans for Certain Applicants and Water Right Holders) applies. Impacts of the drought management measures on water needs must be consistent with guidance provided by the Commission in its administrative rules implementing Texas Water Code §11.1272. If a RWPG does not adopt a drought management strategy for a need it must document the reason in the RWP.	Yes	Chapter 7 and Subchapter 5A - Drought management considered for all users with needs but not recommended.	§357.33 §11.1272
(f) (2)	Must consider water conservation practices, including potentially applicable best management practices, for each identified water need.	Yes	Subchapter 5B, 5C and 5D	
(f) (2) (A)	Include water conservation practices for each user group to which Texas Water Code §11.1271 and §13.146 (relating to Water Conservation Plans) apply. The impact of these water conservation practices on water needs must be consistent with requirements in appropriate Commission administrative rules.	Yes	Subchapter 5B and Attachment 5-2	§11.1271 §13.146
(f) (2) (B)	Consider water conservation practices for each WUG beyond the minimum requirements of subparagraph (A) of this paragraph, whether or not the WUG is subject to Texas Water Code §11.1271 and §13.146. If RWPGs do not adopt a water conservation strategy to meet an identified need, they shall document the reason in the RWP.	Yes	Subchapters 5B, 5C, 5D and Attachment 5-2	§11.1271 §13.146
(f) (2) (C)	For each WUG or WWP that is to obtain water from a proposed interbasin transfer, RWPGs will include a water conservation strategy that will result in the highest practicable level of water conservation and efficiency achievable.	NA	There are no new interbasin strategies for PWPA.	§11.085
(f) (2) (D)	Consider strategies to address any issues identified in the information compiled by the Board from the water loss audits performed by retail public utilities pursuant to §358.6 of this title (relating to Water Loss Audits).	Yes	Subchapter 5B	§358.6
(g)	Include a subchapter consolidating the RWPG's recommendations regarding water conservation. RWPGs shall include in the RWPs model water conservation plans pursuant to Texas Water Code §11.1271	Yes	Subchapter 5B	§11.1271
31 TAC §357.35				
357.35 (a)	Recommend water management strategies to be used during a drought of record based on the potentially feasible water management strategies evaluated under §357.34 of this title (relating to Identification and Evaluation of Potentially Feasible Water Management Strategies).	Yes	Chapter 5, Attachments 5-1 through 5-3	§357.34
(b)	Recommend specific water management strategies based upon the identification, analysis, and comparison of water management strategies by the RWPG that the RWPG determines are potentially feasible so that the cost effective water management strategies that are environmentally sensitive are considered and adopted unless a RWPG demonstrates that adoption of such strategies is inappropriate.	Yes	Chapter 5, Attachments 5-1 through 5-3	§357.34
(c)	Strategies will be selected by the RWPGs so that cost effective water management strategies, which are consistent with long-term protection of the state's water resources, agricultural resources, and natural resources are adopted.	Yes	Chapter 5, Attachments 5-1 through 5-3	
(d)	Identify and recommend water management strategies for all WUGs and WWPs with identified water needs and that meet all water needs during the drought of record except in cases where: (1) no water management strategy is feasible. In such cases, RWPGs must explain why no management strategies are feasible; or (2) a political subdivision that provides water supply other than water supply corporations, counties, or river authorities explicitly does not participate in the regional water planning process for needs located within its boundaries or extraterritorial jurisdiction.	Yes	Chapter 5, Attachments 5-1 through 5-3	
(e)	Specific recommendations of water management strategies to meet an identified need will not be shown as meeting a need for a political subdivision if the political subdivision in question objects to inclusion of the strategy for the political subdivision and specifies its reasons for such objection. This does not prevent the inclusion of the strategy to meet other needs.	Yes	Chapter 5, Attachments 5-1 through 5-3	
(f)	Recommended strategies shall protect existing water rights, water contracts, and option agreements, but may consider potential amendments of water rights, contracts and agreements, which would require the eventual consent of the owner.	Yes	Chapter 5, Attachments 5-1 through 5-3	
(g)	RWPGs shall report the following			
(g) (1)	Recommended water management strategies and the associated results of all the potentially feasible water management strategy evaluations by WUG and WWP. If a WUG or WWP lies in one or more counties or RWPAs or river basins, data will be reported for each river basin, RWPA, and county.	Yes	Chapter 5, Data table reports in Appendix K	
(g) (2)	Calculated planning management supply factors for each WUG and WWP included in the RWP assuming all recommended water management strategies are implemented. This calculation shall be based on the sum of: the total existing water supplies, plus all water supplies from recommended water management strategies for each entity; divided by that entity's total projected water demand, within the planning decade. The resulting calculated safety factor shall be presented in the plan by entity and decade for every WUG and WWP	Yes	Data table reports in Appendix K	
(g) (3)	Fully evaluated Alternative Water Management Strategies included in the adopted RWP shall be presented together in one place in the RWP.	Yes	Attachment 5-2 and Attachment 5-3	
Chapter Six Impacts of Regional Water Plan and Consistency with Protection of Water Resources, Agricultural Resources, and Natural Resources				

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
31 TAC §357.40				
357.40 (a)	RWPs shall include a description of the impacts of the RWP regarding:			
(b) (1)	Agricultural resources pursuant to §357.34(d)(3)(C) of this title (relating to Identification and Evaluation of Potentially Feasible Water Management Strategies)	Yes	Chapter 6 and Attachment 5-3	§357.34(d)(3)(C)
(b) (2)	Other water resources of the state including other water management strategies and groundwater and surface water interrelationships pursuant to §357.34(d)(4) of this title	Yes	Chapter 6 and Attachment 5-3	§357.34(d)(4)
(b) (3)	Threats to agricultural and natural resources identified pursuant to §357.34(d)(5) of this title	Yes	Chapter 6 and Attachment 5-3	§357.34(d)(5)
(b) (4)	Third-party social and economic impacts resulting from voluntary redistributions of water including analysis of third-party impacts of moving water from rural and agricultural areas pursuant to §357.34(d)(7) of this title	Yes	Chapter 6	§357.34(d)(7)
(b) (5)	Major impacts of recommended water management strategies on key parameters of water quality pursuant to §357.34(d)(8) of this title	Yes	6.1	§357.34(d)(8)
(b) (6)	Effects on navigation	Yes	6.4 - The PWPA Plan does not have an impact on navigation.	
(c)	Include a summary of the identified water needs that remain unmet by the RWP.	Yes	Subchapter 5D	
31 TAC §357.41				
357.41	Describe how RWPs are consistent with the long-term protection of the state's water resources, agricultural resources, and natural resources as embodied in the guidance principles in §358.3(4) and (8) of this title (relating to Guidance Principles).	Yes	6.6, 6.7, 6.8, 6.9,and 6.10	§358.3(4) and (8)
Chapter Seven Drought Response Information, Activities, and Recommendations				
31 TAC §357.42				
357.42 (a)	Consolidate and present information on current and planned preparations for, and responses to, drought conditions in the region including, but not limited to, drought of record conditions based on the following subsections.	Yes	Chapter 7	
(b)	Conduct an overall assessment of current preparations for drought within the RWPA including a description of how water suppliers in the RWPA identify and respond to the onset of drought. This may include information from local drought contingency plans.	Yes	7.2	
(c)	Develop drought response recommendations regarding the management of existing groundwater and surface water sources in the RWPA designated in accordance with §357.32 of this title (relating to Water Supply Analysis), including:			
(c) (1)	Factors specific to each source of water supply to be considered in determining whether to initiate a drought response for each water source including specific recommended drought response triggers	Yes	7.5	§357.32
(c) (2)	Actions to be taken as part of the drought response by the manager of each water source and the entities relying on each source, including the number of drought stages	Yes	7.5 and Attachment 7-1	§357.32
(c) (3)	Triggers and actions developed in paragraphs (1) and (2) of this subsection may consider existing triggers and actions associated with existing drought contingency plans.	Yes	7.5 and Attachment 7-1	§357.32
(d)	Collect information on existing major water infrastructure facilities that may be used for interconnections in event of an emergency shortage of water. In accordance with Texas Water Code §16.053(r), this information is CONFIDENTIAL INFORMATION and cannot be disseminated to the public. The associated information is to be collected by a subgroup of RWPG members in a closed meeting and submitted separately to the EA in accordance with guidance to be provided by EA.	Yes	No confidential information received.	Texas Water Code §16.053(r)
(e)	Provide general descriptions of local drought contingency plans that involve making emergency connections between water systems or WWP systems that do not include locations or descriptions of facilities that are disallowed under subsection (d) of this section.	Yes	7.4	
(f)	RWPGs may designate recommended and alternative drought management water management strategies and other recommended drought measures in the RWP including:			
(f) (1)	List and description of the recommended drought management water management strategies and associated WUGs and WWPs, if any, that are recommended by the RWPG. Information to include associated triggers to initiate each of the recommended drought management water management strategies	NA	7.6 - PWPG does not recommend specific drought management strategies. PWPG recommends the implementation of drought contingency plans by suppliers when appropriate to reduce demand during drought and prolong current supplies.	
(f) (2)	List and description of alternative drought management water management strategies and associated WUGs and WWPs, if any, that are included in the plan. Information to include associated triggers to initiate each of the alternative drought management water management strategies	NA	No alternative drought management strategies were included in the PWPA Plan.	
(f) (3)	List of all potentially feasible drought management water management strategies that were considered or evaluated by the RWPG but not recommended	NA	PWPG does not recommend specific drought management strategies.	
(f) (4)	List and summary of any other recommended drought management measures, if any, that are included in the RWP, including associated triggers if applicable	NA	PWPG does not recommend specific drought management strategies.	

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
(g)	Evaluate potential emergency responses to local drought conditions or loss of existing water supplies; the evaluation shall include identification of potential alternative water sources that may be considered for temporary emergency use by WUGs and WWPs in the event that the existing water supply sources become temporarily unavailable to the WUGs and WWPs due to unforeseeable hydrologic conditions such as emergency water right curtailment, unanticipated loss of reservoir conservation storage, or other localized drought impacts. RWPGs shall evaluate, at a minimum, municipal WUGs that: (1) have existing populations less than 7,500 (2) rely on a sole source for its water supply regardless of whether the water is provided by a WWP (3) all county-other WUGs	Yes	7.4	
(h)	Consider any relevant recommendations from the Drought Preparedness Council.	Yes	Chapter 7	
(i)	Make drought preparation and response recommendations regarding:			
(i) (1)	Development of, content contained within, and implementation of local drought contingency plans required by the Commission	Yes	7.2, 7.5 and Attachment 7-1	
(i) (2)	Current drought management preparations in the RWPA including: (A) drought response triggers; and (B) responses to drought conditions;	Yes	7.2, 7.5 and Attachment 7-1	
(i) (3)	The Drought Preparedness Council and the State Drought Preparedness Plan	Yes	7.7.1	
(i) (4)	Any other general recommendations regarding drought management in the region or state	Yes	7.7.2	
(j)	Develop region-specific model drought contingency plans.	Yes	7.5.3, http://www.panhandlewater.org/	
Chapter Eight Policy Recommendations and Unique Sites				
31 TAC §357.43				
357.43 (a)	The RWPs shall contain any regulatory, administrative, or legislative recommendations developed by the RWPGs	Yes	8.5, 8.6, 8.7	
(b)	May include in adopted RWPs recommendations for all or parts of river and stream segments of unique ecological value located within the RWPA by preparing a recommendation package consisting of a physical description giving the location of the stream segment, maps, and photographs of the stream segment and a site characterization of the stream segment documented by supporting literature and data. The recommendation package shall address each of the criteria for designation of river and stream segments of ecological value found in this subsection. The RWPG shall forward the recommendation package to the Texas Parks and Wildlife Department and allow the Texas Parks and Wildlife Department 30 days for its written evaluation of the recommendation. The adopted RWP shall include, if available, Texas Parks and Wildlife Department's written evaluation of each river and stream segment recommended as a river or stream segment of unique ecological value.	NA	8.3	
(b) (1)	May recommend a river or stream segment as being of unique ecological value based upon the criteria set forth in §358.2 of this title (relating to Definitions)	NA	8.3	§358.2
(b) (2)	For every river and stream segment that has been designated as a unique river or stream segment by the legislature, during a session that ends not less than one year before the required date of submittal of an adopted RWP to the Board, or recommended as a unique river or stream segment in the RWP, the RWPG shall assess the impact of the RWP on these segments. The assessment shall be a quantitative analysis of the impact of the plan on the flows important to the river or stream segment, as determined by the RWPG, comparing current conditions to conditions with implementation of all recommended water management strategies. The assessment shall also describe the impact of the plan on the unique features cited in the region's recommendation of that segment	NA	8.3	
(c)	May recommend sites of unique value for construction of reservoirs by including descriptions of the sites, reasons for the unique designation and expected beneficiaries of the water supply to be developed at the site. The criteria at §358.2 of this title shall be used to determine if a site is unique for reservoir construction.	NA	8.4	§358.2
(d)	Any other recommendations that the RWPG believes are needed and desirable to achieve the stated goals of state and regional water planning including to facilitate the orderly development, management, and conservation of water resources and prepare for and respond to drought conditions.	Yes	8.8	
(e)	May develop information as to the potential impacts of any proposed changes in law prior to or after changes are enacted.	Yes	8.5	
(f)	Consider making legislative recommendations to facilitate more voluntary water transfers in the region.	Yes	8.5	
Chapter Nine Infrastructure Financing Analysis				
31 TAC §357.44				
357.44	Assess and quantitatively report on how individual local governments, regional authorities, and other political subdivisions in their RWPA propose to finance recommended water management strategies.	Yes	Appendix H	
Chapter Ten Public Participation and Plan Adoption				
31 TAC §357.21				
357.21 (a)	Conduct all business in meetings posted and held in accordance with the Texas Open Meetings Act, Texas Government Code Chapter 551, with a copy of all materials presented or discussed available for public inspection prior to and following the meetings.	Yes	Chapter 10	Texas Government Code Chapter 551
(b-d)	All public notices required by the TWDB by the RWPG shall comply with 31 TAC §357.21 and shall meet the requirements specified therein.	Yes	Chapter 10	
31 TAC §357.50				

Regulatory Citation (Col 1)	Summary of Requirement (Col 2)	Response (Yes/No/ NA) (Col 3)	Location(s) in Regional Plan and/or Commentary (Col 4)	Regulatory Cross References (Col 5)
357.5 (a)	Submit their adopted RWPs to the Board every five years on a date to be disseminated by the EA, as modified by subsection (e)(2) of this section, for approval and inclusion in the state water plan.	Yes	The PWPA Water Plan will be submitted to the EA accordingly.	
(b)	Prior to the adoption of the RWP, the RWPGs shall submit concurrently to the EA and the public an IPP. The IPP submitted to the EA must be in the electronic and paper format specified by the EA. Each RWPG must certify that the IPP is complete and adopted by the RWPG.	Yes	Chapter 10	
(c)	Distribute the IPP in accordance with §357.21(d)(5) of this title (relating to Notice and Public Participation).	Yes	Plan was distributed by May 1, 2015	
(d)	Solicit, and consider the necessary comments when adopting a RWP.	Yes	Comments are included in Chapter 10 and Appendix I.	
(e)	Submit the IPP and the adopted RWPs and amendments to approved RWPs to the EA in conformance with 31 TAC §357.50 (e).	Yes	The PWPA Water Plan was submitted to the EA accordingly.	
(f)	Submit in a timely manner to the EA information on any known interregional conflict between RWPs.	NA	There are no known interregional conflicts between RWPs.	
(g)	Modify the RWP to incorporate Board resolutions of interregional conflicts	NA	See above	
(h)	Seek to resolve conflicts with other RWPGs and shall participate in any Board sponsored efforts to resolve interregional conflicts.	NA	See above	
Chapter Eleven Implementation and Comparison to the Previous Regional Water Plan				
31 TAC §357.45				
357.45 (a)	Describe the level of implementation of previously recommended water management strategies. Information on the progress of implementation of all water management strategies that were recommended in the previous RWP, including conservation and drought management water management strategies; and the implementation of projects that have affected progress in meeting the state's future water needs.	Yes	11.3	
(b)	RWPGs shall provide a brief summary of how the RWP differs from the previously adopted RWP with regards to:			
(b) (1)	Water demand projections	Yes	11.2.2	
(b) (2)	Drought of record and hydrologic and modeling assumptions used in planning for the region	Yes	11.2.3	
(b) (3)	Groundwater and surface water availability, existing water supplies, and identified water needs for WUGs and WWPs	Yes	11.2.4, 11.2.5, 11.2.6, 11.2.7	
(b) (4)	Recommended and alternative water management strategies.	Yes	11.2.7	

Appendix G

Socio-economic Impacts

Socioeconomic Impacts of Projected Water Shortages

for the Region A Regional Water Planning Area

Prepared in Support of the 2016 Region A Regional Water Plan

Texas Water Development Board

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Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required part of the regional water planning process. The Texas Water Development Board (TWDB) estimates those impacts for regional water planning groups, and summarizes the impacts in the state water plan. The analysis presented is for the Region A Regional Water Planning Group.

Based on projected water demands and existing water supplies, the Region A planning group identified water needs (potential shortages) that would occur within its region under a repeat of the drought of record for six water use categories. The TWDB then estimated the socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

The analysis was performed using an economic modeling software package, IMPLAN (Impact for Planning Analysis), as well as other economic analysis techniques, and represents a snapshot of socioeconomic impacts that may occur during a single year during a drought of record within each of the planning decades. For each water use category, the evaluation focused on estimating income losses and job losses. The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts were estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

It is estimated that not meeting the identified water needs in Region A would result in an annually combined lost income impact of approximately $219 million in 2020, increasing to $3.3 billion in 2070 (Table ES-1). In 2020, the region would lose approximately 3,100 jobs, and by 2070 job losses would increase to approximately 52,300.

All impact estimates are in year 2013 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from the TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and Texas Municipal League.

Table ES-1: Region A Socioeconomic Impact Summary

Regional Economic Impacts	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$219	$424	$708	$1,166	$2,171	$3,312
Job losses	3,138	6,194	10,536	16,185	32,489	52,273
Financial Transfer Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Tax losses on production and imports ($ millions)*	$14	$27	$47	$77	$155	$246
Water trucking costs ($ millions)*	-	$0	$0	$1	$1	$2
Utility revenue losses ($ millions)*	$20	$41	$64	$86	$93	$134
Utility tax revenue losses ($ millions)*	$0	$1	$1	$1	$2	$2
Social Impacts	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Consumer surplus losses ($ millions)*	$1	$7	$22	$43	$92	$175
Population losses	576	1,137	1,934	2,972	5,965	9,597
School enrollment losses	107	210	358	550	1,104	1,775

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on existing businesses and industry, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

Administrative rules (31 Texas Administrative Code §357.33 (c)) require that regional water planning groups evaluate the social and economic impacts of not meeting water needs as part of the regional water planning process, and rules direct the TWDB staff to provide technical assistance upon request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of the Region A Regional Water Planning Group.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 summarizes the water needs calculation performed by the TWDB based on the regional water planning group's data. Section 2 describes the methodology for the impact assessment and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 3 presents the results for each water use category with results summarized for the region as a whole. Appendix A presents details on the socioeconomic impacts by county.

1.1 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for each water user group (WUG) with input from the planning groups. WUGs are composed of cities, utilities, combined rural areas (designated as county-other), and the county-wide water use of irrigation, livestock, manufacturing, mining and steam-electric power. The demands are then compared to the existing water supplies of each WUG to determine potential shortages, or needs, by decade. Existing water supplies are legally and physically accessible for immediate use in the event of drought. Projected water demands and existing supplies are compared to identify either a surplus or a need for each WUG.

Table 1-1 summarizes the region's identified water needs in the event of a repeat of drought of the record. Demand management, such as conservation, or the development of new infrastructure to increase supplies are water management strategies that may be recommended by the planning group to meet those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population and economic growth. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are presented in aggregate in Table 1-1. Projected needs for individual water user groups within the aggregate vary greatly, and may reach 100% for a given WUG and water use category. Detailed water needs by WUG and county appear in Chapter 4 of the 2016 Region A Regional Water Plan.

Table 1-1 Regional Water Needs Summary by Water Use Category

Water Use Category		2020	2030	2040	2050	2060	2070
Irrigation	Water Needs (acre-feet per year)	156,704	185,043	192,876	180,151	165,133	148,519
	% of the category's total water demand	10%	13%	15%	15%	16%	17%
Livestock	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Manufacturing	Water Needs (acre-feet per year)	4,941	7,529	10,219	14,243	18,369	22,538
	% of the category's total water demand	10%	14%	18%	25%	30%	35%
Mining	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Municipal	Water Needs (acre-feet per year)	12,528	24,073	37,971	52,057	66,265	80,964
	% of the category's total water demand	14%	24%	36%	45%	53%	61%
Steam-electric power	Water Needs (acre-feet per year)	-	-	-	-	-	-
	% of the category's total water demand	-	-	-	-	-	-
Total water needs		**174,173**	**216,645**	**241,066**	**246,451**	**249,767**	**252,021**

2 Economic Impact Assessment Methodology Summary

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate (volume), and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts were based on the overall composition of the economy using many underlying economic "sectors." Sectors in this analysis refer to one or more of the 440 specific production sectors of the economy designated within IMPLAN (Impact for Planning Analysis), the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 310 of those sectors, with the focus on the more water intense production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple related economic sectors.

2.1 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic impacts of shortages due to a drought of record. Consistent with previous water plans, several key variables were estimated and are described in Table 2-1.

Table 2-1 Socioeconomic Impact Analysis Measures

Regional Economic Impacts	**Description**
Income losses - value added	The value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry, sector, or group of sectors within a year. For a shortage, value added is a measure of the income losses to the region, county, or WUG and includes the direct, indirect and induced monetary impacts on the region.
Income losses - electrical power purchase costs	Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages.
Job losses	Number of part-time and full-time jobs lost due to the shortage.
Financial Transfer Impacts	**Description**
Tax losses on production and imports	Sales and excise taxes (not collected due to the shortage), customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies.
Water trucking costs	Estimate for shipping potable water.
Utility revenue losses	Foregone utility income due to not selling as much water.
Utility tax revenue losses	Foregone miscellaneous gross receipts tax collections.
Social Impacts	**Description**
Consumer surplus losses	A welfare measure of the lost value to consumers accompanying less water use.
Population losses	Population losses accompanying job losses.
School enrollment losses	School enrollment losses (K-12) accompanying job losses.

2.1.1 Regional Economic Impacts

Two key measures were included within the regional economic impacts classification: income losses and job losses. Income losses presented consist of the sum of value added losses and additional purchase costs of electrical power. Job losses are also presented as a primary economic impact measure.

Income Losses - Value Added Losses

Value added is the value of total output less the value of the intermediate inputs also used in production of the final product. Value added is similar to Gross Domestic Product (GDP), a familiar measure of the productivity of an economy. The loss of value added due to water shortages was estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region.

Income Losses - Electric Power Purchase Costs

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur, and were represented in this analysis by the additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employed additional power purchase costs as a proxy for the value added impacts for that water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it was assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas from the recent drought period in 2011.

Job Losses

The number of jobs lost due to the economic impact was estimated using IMPLAN output associated with the water use categories noted in Table 1-1. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates were not calculated for the steam-electric power production or for certain municipal water use categories.

2.1.2 Financial Transfer Impacts

Several of the impact measures estimated within the analysis are presented as supplemental information, providing additional detail concerning potential impacts on a sub-portion of the economy or government. Measures included in this category include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. Many of these measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

Tax Losses on Production and Imports

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model was used to estimate reduced tax collections associated with the reduced output in the economy.

Water Trucking Costs

In instances where water shortages for a municipal water user group were estimated to be 80 percent or more of water demands, it was assumed that water would be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed cost of $20,000 per acre-foot of water was calculated and presented as an economic cost. This water trucking cost was applied for both the residential and non-residential portions of municipal water needs and only impacted a small number of WUGs statewide.

Utility Revenue Losses

Lost utility income was calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates resulted from city-specific pricing data for both water and wastewater. These water rates were applied to the potential water shortage to determine estimates of lost utility revenue as water providers sold less water during the drought due to restricted supplies.

Utility Tax Losses

Foregone utility tax losses included estimates of uncollected miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

2.1.3 Social Impacts

Consumer Surplus Losses of Municipal Water Users

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is willing and able to pay for the commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer’s wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. However, consumer’s access to that water may be limited, and the associated consumer surplus loss is an estimate of the equivalent monetary value of the negative impact to the consumer’s wellbeing, for example, associated with a diminished quality of their landscape (i.e., outdoor use). Lost consumer surplus estimates for reduced outdoor and indoor use, as well as residential and commercial/institutional demands, were included in this analysis. Consumer surplus is an attempt to measure effects on wellbeing by monetizing those effects; therefore, these values should not be added to the other monetary impacts estimated in the analysis.

Lost consumer surplus estimates varied widely by location and type. For a 50 percent shortage, the estimated statewide consumer surplus values ranged from $55 to $2,500 per household (residential use), and from $270 to $17,400 per firm (non-residential).

Population and School Enrollment Losses

Population losses due to water shortages, as well as the related loss of school enrollment, were based upon the job loss estimates and upon a recent study of job layoffs and the resulting adjustment of the labor market, including the change in population.[1] The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model an estimate of the change in the population as the result of a job layoff event. Layoffs impact both out-migration, as well as in-migration into an area, both of which can negatively affect the population of an area. In addition, the study found that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county. Based on this study, a simplified ratio of job and net population losses was calculated for the state as a whole: for every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses were estimated as a proportion of the population lost.

2.2 Analysis Context

The context of the economic impact analysis involves situations where there are physical shortages of surface or groundwater due to drought of record conditions. Anticipated shortages may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

2.2.1 IMPLAN Model and Data

Input-Output analysis using the IMPLAN (Impact for Planning Analysis) software package was the primary means of estimating value added, jobs, and taxes. This analysis employed county and regional level models to determine key impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2011 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 440 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their relevant planning water user categories (manufacturing, mining, irrigation, etc.). Estimates of value added for a water use category were obtained by summing value added estimates across the relevant IMPLAN sectors

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[1] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015. http://paa2015.princeton.edu/uploads/150194

associated with that water use category. Similar calculations were performed for the job and tax losses on production and import impact estimates.

Note that the value added estimates, as well as the job and tax estimates from IMPLAN, include three components:

- *Direct effects* representing the initial change in the industry analyzed;
- *Indirect effects* that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- *Induced effects* that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

2.2.2 Elasticity of Economic Impacts

The economic impact of a water need is based on the relative size of the water need to the water demand for each water user group (Figure 2-1). Smaller water shortages, for example, less than 5 percent, were anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage deepens, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for such ability to adjust, an elasticity adjustment function was used in estimating impacts for several of the measures. Figure 2-1 illustrates the general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage percentage reaches the lower bound b1 (10 percent in Figure 2-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound for adjustment reaches the b2 level shortage (50 percent in Figure 2-1 example).

Initially, the combined total value of the three value added components (direct, indirect, and induced) was calculated and then converted into a per acre-foot economic value based on historical TWDB water use estimates within each particular water use category. As an example, if the total, annual value added for livestock in the region was $2 million and the reported annual volume of water used in that industry was 10,000 acre-feet, the estimated economic value per acre-foot of water shortage would be $200 per acre-foot. Negative economic impacts of shortages were then estimated using this value as the maximum impact estimate ($200 per acre-foot in the example) applied to the anticipated shortage volume in acre-feet and adjusted by the economic impact elasticity function. This adjustment varied with the severity as percentage of water demand of the anticipated shortage. If one employed the sample elasticity function shown in Figure 2-1, a 30% shortage in the water use category would imply an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments were not required in estimating consumer surplus, nor for the estimates of utility revenue losses or utility tax losses. Estimates of lost consumer surplus relied on city-specific demand curves with the specific lost consumer surplus estimate calculated based on the relative percentage of the city's water shortage. Estimated changes in population as well as changes in school enrollment were indirectly related to the elasticity of job losses.

Assumed values for the bounds b1 and b2 varied with water use category under examination and are presented in Table 2-2.

Figure 2-1 Example Economic Impact Elasticity Function (as applied to a single water user's shortage)

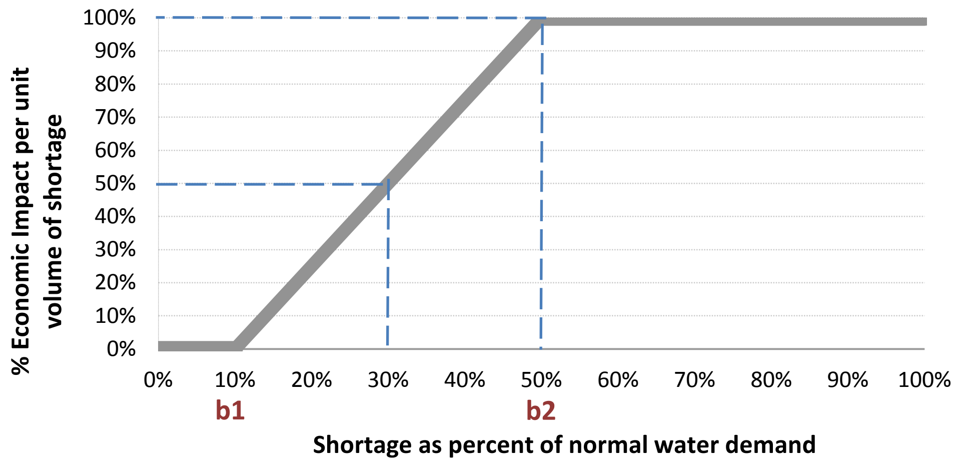

Table 2-2 Economic Impact Elasticity Function Lower and Upper Bounds

Water Use Category	Lower Bound (b1)	Upper Bound (b2)
Irrigation	**5%**	**50%**
Livestock	**5%**	**10%**
Manufacturing	**10%**	**50%**
Mining	**10%**	**50%**
Municipal (non-residential water intensive)	**50%**	**80%**
Steam-electric power	**20%**	**70%**

2.3 Analysis Assumptions and Limitations

Modeling of complex systems requires making assumptions and accepting limitations. This is particularly true when attempting to estimate a wide variety of economic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of the methodology include:

1. The foundation for estimating socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified as part of the regional water planning process. These needs have some uncertainty associated with them, but serve as a reasonable basis for evaluating potential economic impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshot estimates of impacts for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates are independent and distinct "what if" scenarios for each particular year, and water shortages are assumed to be temporary events resulting from severe drought conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs, future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented were not cumulative (i.e., summing up expected impacts from today up to the decade noted), but were simply an estimate of the magnitude of annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, supplies of limited resources, and other structural changes to the economy that may occur into the future. This was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This analysis is not a cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting procedures to weigh future costs differently through time.

5. Monetary figures are reported in constant year 2013 dollars.

6. Impacts are annual estimates. The estimated economic model does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

7. Value added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two categories (value added and consumer surplus) are both valid impacts but should not be summed.

8. The value added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects described in Section 2.2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

9. The majority of impacts estimated in this analysis may be considered smaller than those that might occur under drought of record conditions. Input-output models such as IMPLAN only capture "backward linkages" on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in these types of economic impact modeling efforts, it is important to note that "forward linkages" on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, which is one reason why the impact estimates are likely conservative.

10. The methodology did not capture "spillover" effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

11. The model did not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to the landscaping industry immediately following a drought;
    b. The cost and years to rebuild liquidated livestock herds (a major capital item in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas' ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not accurately reflect what might occur on a statewide basis.

13. The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers. Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

3 Analysis Results

This section presents a breakdown of the results of the regional analysis for Region A. Projected economic impacts for six water use categories (irrigation, livestock. municipal, manufacturing, mining, and steam-electric power) are also reported by decade.

3.1 Overview of the Regional Economy

Table 3-1 presents the 2011 economic baseline as represented by the IMPLAN model and adjusted to 2013 dollars for Region A. In year 2011, Region A generated about $20 billion in gross state product associated with 231,000 jobs based on the 2011 IMPLAN data. These values represent an approximation of the current regional economy for a reference point.

Table 3-1 Region A Economy

Income ($ millions)*	Jobs	Taxes on production and imports ($ millions)*
$20,300	**230,660**	**$1,789**

[1]*Year 2013 dollars based on 2011 IMPLAN model value added estimates for the region.*

The remainder of Section 3 presents estimates of potential economic impacts for each water use category that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented.

3.2 Impacts for Irrigation Water Shortages

Three of the 21 counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-2. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. Two factors led to excluding any reported tax impacts: 1) Federal support (subsidies) has lessened greatly since the year 2011 IMPLAN data was collected, and 2) It was not considered realistic to report increasing tax revenue collections for a drought of record.

Table 3-2 Impacts of Water Shortages on Irrigation in Region

Impact Measure	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$20	$31	$38	$38	$35	$32
Job losses	338	531	645	639	588	540

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.3 Impacts for Livestock Water Shortages

None of the 21 counties in the region are projected to experience water shortages in the livestock water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-3. Note that tax impacts are not reported for this water use category for similar reasons that apply to the irrigation water use category described above.

Table 3-3 Impacts of Water Shortages on Livestock in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	-	-	-	-	-	-
Jobs losses	-	-	-	-	-	-

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

3.4 Impacts for Municipal Water Shortages

Fourteen of the 21 counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon. Impact estimates were made for the two subtypes of use within municipal use: residential, and non-residential. The latter includes commercial and institutional users. Consumer surplus measures were made for both residential and non-residential demands. In addition, available data for the non-residential, water-intensive portion of municipal demand allowed use of IMPLAN and TWDB Water Use Survey data to estimate income loss, jobs, and taxes. Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed cost of $20,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 3-4.

Table 3-4 Impacts of Water Shortages on Municipal Water Users in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses[1] ($ millions)*	$3	$19	$53	$135	$762	$1,586
Job losses[1]	57	381	1,059	2,672	15,093	31,429
Tax losses on production and imports[1] ($ millions)*	$0	$2	$5	$12	$66	$138
Consumer surplus losses ($ millions)*	$1	$7	$22	$43	$92	$175
Trucking costs ($ millions)*	-	$0	$0	$1	$1	$2
Utility revenue losses ($ millions)*	$20	$41	$64	$86	$93	$134
Utility tax revenue losses ($ millions)*	-	$1	$1	$1	$2	$2

[1] Estimates apply to the water-intensive portion of non-residential municipal water use.
**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.5 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in 5 of the 21 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-5.

Table 3-5 Impacts of Water Shortages on Manufacturing in Region

Impacts Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	$196	$374	$617	$993	$1,375	$1,695
Job losses	2,743	5,282	8,832	12,874	16,807	20,305
Tax losses on production and Imports ($ millions)*	$13	$24	$40	$63	$87	$107

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.6 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in none of the 21 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use type appear in Table 3-6.

Table 3-6 Impacts of Water Shortages on Mining in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income losses ($ millions)*	-	-	-	-	-	-
Job losses	-	-	-	-	-	-
Tax losses on production and Imports ($ millions)*	-	-	-	-	-	-

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.7 Impacts of Steam-Electric Water Shortages

Steam-electric water shortages in the region are projected to occur in none of the 21 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-7.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of the estimated additional purchasing costs for power from the electrical grid that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Does not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

Table 3-7 Impacts of Water Shortages on Steam-Electric Power in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Income Losses ($ millions)*	-	-	-	-	-	-

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

3.8 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 3-8.

Table 3-8 Region-wide Social Impacts of Water Shortages in Region

Impact Measures	2020	2030	2040	2050	2060	2070
Consumer surplus losses ($ millions)*	$1	$7	$22	$43	$92	$175
Population losses	576	1,137	1,934	2,972	5,965	9,597
School enrollment losses	107	210	358	550	1,104	1,775

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

Appendix A - County Level Summary of Estimated Economic Impacts for Region A

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2013 dollars, rounded). Values presented only for counties with projected economic impacts for at least one decade.

**** Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

		Income losses (Million $)*						Job losses						Consumer Surplus (Million $)*					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
ARMSTRONG	MUNICIPAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	$0	$0	$0
ARMSTRONG Total		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**$0**	**$0**	**$0**
CARSON	MUNICIPAL	-	$11	$12	$12	$12	$12	-	214	239	237	236	236	$0	$2	$2	$2	$2	$2
CARSON Total		**-**	**$11**	**$12**	**$12**	**$12**	**$12**	**-**	**214**	**239**	**237**	**236**	**236**	**$0**	**$2**	**$2**	**$2**	**$2**	**$2**
DALLAM	IRRIGATION	$10	$15	$17	$17	$15	$14	169	254	299	293	266	239	-	-	-	-	-	-
DALLAM	MUNICIPAL	-	-	$0	$11	$24	$41	-	-	2	213	483	803	$0	$0	$1	$1	$3	$6
DALLAM Total		**$10**	**$15**	**$17**	**$28**	**$40**	**$54**	**169**	**254**	**301**	**506**	**749**	**1,042**	**$0**	**$0**	**$1**	**$1**	**$3**	**$6**
GRAY	MUNICIPAL	-	-	$12	-	$11	$38	-	-	232	-	215	756	-	$1	$3	$1	$4	$9
GRAY Total		**-**	**-**	**$12**	**-**	**$11**	**$38**	**-**	**-**	**232**	**-**	**215**	**756**	**-**	**$1**	**$3**	**$1**	**$4**	**$9**
HALL	MUNICIPAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	$0	$0	$0
HALL Total		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	$0	$0	$0
HANSFORD	MUNICIPAL	-	-	-	$0	$5	$12	-	-	-	3	99	247	-	-	$0	$0	$1	$4
HANSFORD Total		**-**	**-**	**-**	**$0**	**$5**	**$12**	**-**	**-**	**-**	**3**	**99**	**247**	**-**	**-**	**$0**	**$0**	**$1**	**$4**
HARTLEY	IRRIGATION	$10	$16	$21	$21	$19	$18	169	278	345	346	322	298	-	-	-	-	-	-
HARTLEY	MUNICIPAL	-	-	$0	$4	$8	$13	-	-	1	77	163	253	-	$0	$0	$0	$1	$2
HARTLEY Total		**$10**	**$16**	**$21**	**$24**	**$27**	**$31**	**169**	**278**	**346**	**424**	**485**	**552**	**-**	**$0**	**$0**	**$0**	**$1**	**$2**
HUTCHINSON	MANUFACTURING	-	-	-	-	$9	$32	-	-	-	-	28	104	-	-	-	-	-	-
HUTCHINSON	MUNICIPAL	-	-	-	$3	$7	$20	-	-	-	60	145	400	$0	$0	$0	$1	$2	$4
HUTCHINSON Total		**-**	**-**	**-**	**$3**	**$16**	**$52**	**-**	**-**	**-**	**60**	**173**	**504**	**$0**	**$0**	**$0**	**$1**	**$2**	**$4**
LIPSCOMB	MANUFACTURING	-	-	$0	$3	$6	$8	-	-	2	66	119	152	-	-	-	-	-	-
LIPSCOMB	MUNICIPAL	-	-	-	-	$1	$3	-	-	-	-	14	67	-	-	$0	$0	$0	$0
LIPSCOMB Total		**-**	**-**	**$0**	**$3**	**$7**	**$11**	**-**	**-**	**2**	**66**	**133**	**219**	**-**	**-**	**$0**	**$0**	**$0**	**$0**
MOORE	IRRIGATION	-	-	-	-	-	$0	-	-	-	-	-	2	-	-	-	-	-	-
MOORE	MANUFACTURING	$45	$77	$108	$325	$553	$697	321	544	764	2,297	3,914	4,932	-	-	-	-	-	-
MOORE	MUNICIPAL	$3	$8	$28	$46	$86	$133	57	167	550	908	1,695	2,644	$0	$1	$6	$9	$12	$20

		Income losses (Million $)*						Job losses						Consumer Surplus (Million $)*					
County	Water Use Category	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
MOORE Total		**$48**	**$85**	**$136**	**$370**	**$639**	**$831**	**378**	**711**	**1,314**	**3,205**	**5,609**	**7,578**	**$0**	**$1**	**$6**	**$9**	**$12**	**$20**
OCHILTREE	MUNICIPAL	-	-	-	$5	$17	$30	-	-	-	97	330	586	$0	$0	$0	$1	$3	$5
OCHILTREE Total		**-**	**-**	**-**	**$5**	**$17**	**$30**	**-**	**-**	**-**	**97**	**330**	**586**	**$0**	**$0**	**$0**	**$1**	**$3**	**$5**
POTTER	MANUFACTURING	$151	$292	$490	$635	$768	$910	2,422	4,682	7,869	10,188	12,337	14,618	-	-	-	-	-	-
POTTER	MUNICIPAL	-	-	-	$16	$279	$648	-	-	-	317	5,523	12,833	$0	$1	$4	$11	$24	$51
POTTER Total		**$151**	**$292**	**$490**	**$651**	**$1,047**	**$1,558**	**2,422**	**4,682**	**7,869**	**10,506**	**17,860**	**27,451**	**$0**	**$1**	**$4**	**$11**	**$24**	**$51**
RANDALL	MANUFACTURING	-	$5	$19	$31	$39	$47	-	56	197	323	409	498	-	-	-	-	-	-
RANDALL	MUNICIPAL	-	-	$0	$34	$306	$628	-	-	4	679	6,068	12,444	$0	$2	$5	$15	$39	$70
RANDALL Total		**-**	**$5**	**$19**	**$65**	**$345**	**$675**	**-**	**56**	**201**	**1,001**	**6,477**	**12,942**	**$0**	**$2**	**$5**	**$15**	**$39**	**$70**
WHEELER	MUNICIPAL	-	-	$2	$4	$6	$8	-	-	32	80	123	160	$0	$0	$0	$0	$1	$1
WHEELER Total		**-**	**-**	**$2**	**$4**	**$6**	**$8**	**-**	**-**	**32**	**80**	**123**	**160**	**$0**	**$0**	**$0**	**$0**	**$1**	**$1**
Grand Total		**$219**	**$424**	**$708**	**$1,166**	**$2,171**	**$3,312**	**3,138**	**6,194**	**10,536**	**16,185**	**32,489**	**52,273**	**$1**	**$7**	**$22**	**$43**	**$92**	**$175**

Appendix H

Infrastructure Financing Survey Results

PWPA INFRASTRUCTURE FINANCING SURVEY RESULTS

SponsorEntityName	SponsorEntity PrimaryRegion	ProjectName	WMSProject SponsorRegion	IFRElementName	IFRElementValue	YearOfNeed	IFRProject DataId	EntityRwpId	WMSProjectId	IFRProject ElementsId
AMARILLO	A	DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2	882	1
AMARILLO	A	DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	CONSTRUCTION FUNDING				2	882	2
AMARILLO	A	DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2	882	3
AMARILLO	A	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2	881	1
AMARILLO	A	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	CONSTRUCTION FUNDING				2	881	2
AMARILLO	A	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2	881	3
AMARILLO	A	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2	883	1
AMARILLO	A	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	CONSTRUCTION FUNDING				2	883	2
AMARILLO	A	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2	883	3
AMARILLO	A	DIRECT REUSE - AMARILLO	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2	884	1
AMARILLO	A	DIRECT REUSE - AMARILLO	A	CONSTRUCTION FUNDING				2	884	2
AMARILLO	A	DIRECT REUSE - AMARILLO	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2	884	3
BOOKER	A	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				257	769	1
BOOKER	A	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	A	CONSTRUCTION FUNDING				257	769	2
BOOKER	A	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				257	769	3
BORGER	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				12	888	1
BORGER	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	A	CONSTRUCTION FUNDING				12	888	2
BORGER	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				12	888	3
CACTUS	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				17	945	1
CACTUS	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	A	CONSTRUCTION FUNDING				17	945	2
CACTUS	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				17	945	3
CANADIAN	A	MUNICIPAL CONSERVATION - CANADIAN	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				301	774	1
CANADIAN	A	MUNICIPAL CONSERVATION - CANADIAN	A	CONSTRUCTION FUNDING				301	774	2
CANADIAN	A	MUNICIPAL CONSERVATION - CANADIAN	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				301	774	3
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$37,544,850.00	2020		19	887	1
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	A	CONSTRUCTION FUNDING	$212,754,150.00	2021		19	887	2
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			19	887	3
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2030 - CRMWA	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				19	885	1
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2030 - CRMWA	A	CONSTRUCTION FUNDING				19	885	2
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2030 - CRMWA	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				19	885	3
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2050 - CRMWA	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				19	886	1
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2050 - CRMWA	A	CONSTRUCTION FUNDING				19	886	2
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	A	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2050 - CRMWA	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				19	886	3
CANYON	A	DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$3,484,200.00	2020		303	735	1
CANYON	A	DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	A	CONSTRUCTION FUNDING	$8,129,900.00	2025		303	735	2
CANYON	A	DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			303	735	3
CHILDRESS	A	MUNICIPAL CONSERVATION - CHILDRESS	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				317	775	1
CHILDRESS	A	MUNICIPAL CONSERVATION - CHILDRESS	A	CONSTRUCTION FUNDING				317	775	2
CHILDRESS	A	MUNICIPAL CONSERVATION - CHILDRESS	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				317	775	3
CLAUDE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - CLAUDE	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$722,775.00	2020		330	896	1
CLAUDE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - CLAUDE	A	CONSTRUCTION FUNDING	$2,168,325.00	2020		330	896	2
CLAUDE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - CLAUDE	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			330	896	3
CLAUDE	A	MUNICIPAL CONSERVATION - CLAUDE	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				330	776	1
CLAUDE	A	MUNICIPAL CONSERVATION - CLAUDE	A	CONSTRUCTION FUNDING	$721,800.00	2020		330	776	2
CLAUDE	A	MUNICIPAL CONSERVATION - CLAUDE	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			330	776	3
COUNTY-OTHER, HALL	A	ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				462	904	1
COUNTY-OTHER, HALL	A	ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)	A	CONSTRUCTION FUNDING				462	904	2
COUNTY-OTHER, HALL	A	ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				462	904	3
COUNTY-OTHER, HALL	A	MUNICIPAL CONSERVATION - HALL COUNTY OTHER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$165,000.00	2035		462	777	1
COUNTY-OTHER, HALL	A	MUNICIPAL CONSERVATION - HALL COUNTY OTHER	A	CONSTRUCTION FUNDING	$495,000.00	2035		462	777	2
COUNTY-OTHER, HALL	A	MUNICIPAL CONSERVATION - HALL COUNTY OTHER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			462	777	3
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (BRICE-LESLY)	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$74,825.00	2035		462	901	1
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (BRICE-LESLY)	A	CONSTRUCTION FUNDING	$224,475.00	2035		462	901	2
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (BRICE-LESLY)	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			462	901	3
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (ESTELLINE)	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				462	902	1
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (ESTELLINE)	A	CONSTRUCTION FUNDING				462	902	2
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (ESTELLINE)	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				462	902	3
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (TURKEY)	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				462	909	1
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (TURKEY)	A	CONSTRUCTION FUNDING				462	909	2
COUNTY-OTHER, HALL	A	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (TURKEY)	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				462	909	3
COUNTY-OTHER, MOORE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MOORE COUNTY OTHER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				537	737	1
COUNTY-OTHER, MOORE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MOORE COUNTY OTHER	A	CONSTRUCTION FUNDING				537	737	2
COUNTY-OTHER, MOORE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MOORE COUNTY OTHER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				537	737	3
COUNTY-OTHER, POTTER	A	DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				554	916	1
COUNTY-OTHER, POTTER	A	DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER	A	CONSTRUCTION FUNDING				554	916	2
COUNTY-OTHER, POTTER	A	DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				554	916	3
COUNTY-OTHER, POTTER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				554	912	1
COUNTY-OTHER, POTTER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	A	CONSTRUCTION FUNDING				554	912	2
COUNTY-OTHER, POTTER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				554	912	3

SponsorEntityName	SponsorEntity PrimaryRegion	ProjectName	WMSProject SponsorRegion	IFRElementName	IFRElementValue	YearOfNeed	IFRProject DataId	EntityRwpId	WMSProjectId	IFRProject ElementsId
COUNTY-OTHER, POTTER	A	MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				554	778	1
COUNTY-OTHER, POTTER	A	MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	A	CONSTRUCTION FUNDING				554	778	2
COUNTY-OTHER, POTTER	A	MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				554	778	3
COUNTY-OTHER, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY OTHER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				557	733	1
COUNTY-OTHER, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY OTHER	A	CONSTRUCTION FUNDING				557	733	2
COUNTY-OTHER, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY OTHER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				557	733	3
DALHART	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				645	831	1
DALHART	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	A	CONSTRUCTION FUNDING				645	831	2
DALHART	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				645	831	3
DUMAS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				41	766	1
DUMAS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	A	CONSTRUCTION FUNDING				41	766	2
DUMAS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				41	766	3
FRITCH	A	MUNICIPAL CONSERVATION - FRITCH	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				744	779	1
FRITCH	A	MUNICIPAL CONSERVATION - FRITCH	A	CONSTRUCTION FUNDING				744	779	2
FRITCH	A	MUNICIPAL CONSERVATION - FRITCH	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				744	779	3
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				61	895	1
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A	CONSTRUCTION FUNDING				61	895	2
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				61	895	3
GRUVER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				786	773	1
GRUVER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	A	CONSTRUCTION FUNDING				786	773	2
GRUVER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				786	773	3
GRUVER	A	MUNICIPAL CONSERVATION - GRUVER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				786	780	1
GRUVER	A	MUNICIPAL CONSERVATION - GRUVER	A	CONSTRUCTION FUNDING				786	780	2
GRUVER	A	MUNICIPAL CONSERVATION - GRUVER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				786	780	3
IRRIGATION, ARMSTRONG	A	IRRIGATION CONSERVATION - ARMSTRONG COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				884	709	1
IRRIGATION, ARMSTRONG	A	IRRIGATION CONSERVATION - ARMSTRONG COUNTY	A	CONSTRUCTION FUNDING				884	709	2
IRRIGATION, ARMSTRONG	A	IRRIGATION CONSERVATION - ARMSTRONG COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				884	709	3
IRRIGATION, CARSON	A	IRRIGATION CONSERVATION - CARSON COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				910	710	1
IRRIGATION, CARSON	A	IRRIGATION CONSERVATION - CARSON COUNTY	A	CONSTRUCTION FUNDING				910	710	2
IRRIGATION, CARSON	A	IRRIGATION CONSERVATION - CARSON COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				910	710	3
IRRIGATION, CHILDRESS	A	IRRIGATION CONSERVATION - CHILDRESS COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				915	711	1
IRRIGATION, CHILDRESS	A	IRRIGATION CONSERVATION - CHILDRESS COUNTY	A	CONSTRUCTION FUNDING				915	711	2
IRRIGATION, CHILDRESS	A	IRRIGATION CONSERVATION - CHILDRESS COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				915	711	3
IRRIGATION, COLLINGSWORTH	A	IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				921	712	1
IRRIGATION, COLLINGSWORTH	A	IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	A	CONSTRUCTION FUNDING				921	712	2
IRRIGATION, COLLINGSWORTH	A	IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				921	712	3
IRRIGATION, DALLAM	A	IRRIGATION CONSERVATION - DALLAM COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				932	713	1
IRRIGATION, DALLAM	A	IRRIGATION CONSERVATION - DALLAM COUNTY	A	CONSTRUCTION FUNDING				932	713	2
IRRIGATION, DALLAM	A	IRRIGATION CONSERVATION - DALLAM COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				932	713	3
IRRIGATION, DONLEY	A	IRRIGATION CONSERVATION - DONLEY COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				941	714	1
IRRIGATION, DONLEY	A	IRRIGATION CONSERVATION - DONLEY COUNTY	A	CONSTRUCTION FUNDING				941	714	2
IRRIGATION, DONLEY	A	IRRIGATION CONSERVATION - DONLEY COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				941	714	3
IRRIGATION, GRAY	A	IRRIGATION CONSERVATION - GRAY COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				965	715	1
IRRIGATION, GRAY	A	IRRIGATION CONSERVATION - GRAY COUNTY	A	CONSTRUCTION FUNDING				965	715	2
IRRIGATION, GRAY	A	IRRIGATION CONSERVATION - GRAY COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				965	715	3
IRRIGATION, HALL	A	IRRIGATION CONSERVATION - HALL COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				970	716	1
IRRIGATION, HALL	A	IRRIGATION CONSERVATION - HALL COUNTY	A	CONSTRUCTION FUNDING				970	716	2
IRRIGATION, HALL	A	IRRIGATION CONSERVATION - HALL COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				970	716	3
IRRIGATION, HANSFORD	A	IRRIGATION CONSERVATION - HANSFORD COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				972	717	1
IRRIGATION, HANSFORD	A	IRRIGATION CONSERVATION - HANSFORD COUNTY	A	CONSTRUCTION FUNDING				972	717	2
IRRIGATION, HANSFORD	A	IRRIGATION CONSERVATION - HANSFORD COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				972	717	3
IRRIGATION, HARTLEY	A	IRRIGATION CONSERVATION - HARTLEY COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				977	718	1
IRRIGATION, HARTLEY	A	IRRIGATION CONSERVATION - HARTLEY COUNTY	A	CONSTRUCTION FUNDING				977	718	2
IRRIGATION, HARTLEY	A	IRRIGATION CONSERVATION - HARTLEY COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				977	718	3
IRRIGATION, HEMPHILL	A	IRRIGATION CONSERVATION - HEMPHILL COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				980	719	1
IRRIGATION, HEMPHILL	A	IRRIGATION CONSERVATION - HEMPHILL COUNTY	A	CONSTRUCTION FUNDING				980	719	2
IRRIGATION, HEMPHILL	A	IRRIGATION CONSERVATION - HEMPHILL COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				980	719	3
IRRIGATION, HUTCHINSON	A	IRRIGATION CONSERVATION - HUTCHINSON COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				991	720	1
IRRIGATION, HUTCHINSON	A	IRRIGATION CONSERVATION - HUTCHINSON COUNTY	A	CONSTRUCTION FUNDING				991	720	2
IRRIGATION, HUTCHINSON	A	IRRIGATION CONSERVATION - HUTCHINSON COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				991	720	3
IRRIGATION, LIPSCOMB	A	IRRIGATION CONSERVATION - LIPSCOMB COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1019	721	1
IRRIGATION, LIPSCOMB	A	IRRIGATION CONSERVATION - LIPSCOMB COUNTY	A	CONSTRUCTION FUNDING				1019	721	2
IRRIGATION, LIPSCOMB	A	IRRIGATION CONSERVATION - LIPSCOMB COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1019	721	3
IRRIGATION, MOORE	A	IRRIGATION CONSERVATION - MOORE COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1041	722	1
IRRIGATION, MOORE	A	IRRIGATION CONSERVATION - MOORE COUNTY	A	CONSTRUCTION FUNDING				1041	722	2
IRRIGATION, MOORE	A	IRRIGATION CONSERVATION - MOORE COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1041	722	3
IRRIGATION, OCHILTREE	A	IRRIGATION CONSERVATION - OCHILTREE COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1047	723	1
IRRIGATION, OCHILTREE	A	IRRIGATION CONSERVATION - OCHILTREE COUNTY	A	CONSTRUCTION FUNDING				1047	723	2
IRRIGATION, OCHILTREE	A	IRRIGATION CONSERVATION - OCHILTREE COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1047	723	3

SponsorEntityName	SponsorEntity PrimaryRegion	ProjectName	WMSProject SponsorRegion	IFRElementName	IFRElementValue	YearOfNeed	IFRProject DataId	EntityRwpId	WMSProjectId	IFRProject ElementsId
IRRIGATION, OLDHAM	A	IRRIGATION CONSERVATION - OLDHAM COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1048	724	1
IRRIGATION, OLDHAM	A	IRRIGATION CONSERVATION - OLDHAM COUNTY	A	CONSTRUCTION FUNDING				1048	724	2
IRRIGATION, OLDHAM	A	IRRIGATION CONSERVATION - OLDHAM COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1048	724	3
IRRIGATION, POTTER	A	IRRIGATION CONSERVATION - POTTER COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1055	725	1
IRRIGATION, POTTER	A	IRRIGATION CONSERVATION - POTTER COUNTY	A	CONSTRUCTION FUNDING				1055	725	2
IRRIGATION, POTTER	A	IRRIGATION CONSERVATION - POTTER COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1055	725	3
IRRIGATION, RANDALL	A	IRRIGATION CONSERVATION - RANDALL COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1057	726	1
IRRIGATION, RANDALL	A	IRRIGATION CONSERVATION - RANDALL COUNTY	A	CONSTRUCTION FUNDING	$661,700.00			1057	726	2
IRRIGATION, RANDALL	A	IRRIGATION CONSERVATION - RANDALL COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1057	726	3
IRRIGATION, ROBERTS	A	IRRIGATION CONSERVATION - ROBERTS COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1063	727	1
IRRIGATION, ROBERTS	A	IRRIGATION CONSERVATION - ROBERTS COUNTY	A	CONSTRUCTION FUNDING				1063	727	2
IRRIGATION, ROBERTS	A	IRRIGATION CONSERVATION - ROBERTS COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1063	727	3
IRRIGATION, SHERMAN	A	IRRIGATION CONSERVATION - SHERMAN COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1076	728	1
IRRIGATION, SHERMAN	A	IRRIGATION CONSERVATION - SHERMAN COUNTY	A	CONSTRUCTION FUNDING				1076	728	2
IRRIGATION, SHERMAN	A	IRRIGATION CONSERVATION - SHERMAN COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1076	728	3
IRRIGATION, WHEELER	A	IRRIGATION CONSERVATION - WHEELER COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1106	729	1
IRRIGATION, WHEELER	A	IRRIGATION CONSERVATION - WHEELER COUNTY	A	CONSTRUCTION FUNDING				1106	729	2
IRRIGATION, WHEELER	A	IRRIGATION CONSERVATION - WHEELER COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1106	729	3
LAKE TANGLEWOOD	A	DEVELOP OGALLALA AQUIFER SUPPLIES - LAKE TANGLEWOOD	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1190	734	1
LAKE TANGLEWOOD	A	DEVELOP OGALLALA AQUIFER SUPPLIES - LAKE TANGLEWOOD	A	CONSTRUCTION FUNDING				1190	734	2
LAKE TANGLEWOOD	A	DEVELOP OGALLALA AQUIFER SUPPLIES - LAKE TANGLEWOOD	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1190	734	3
LAKE TANGLEWOOD	A	MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1190	782	1
LAKE TANGLEWOOD	A	MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	A	CONSTRUCTION FUNDING				1190	782	2
LAKE TANGLEWOOD	A	MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1190	782	3
MANUFACTURING, MOORE	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - MANUFACTURING MOORE COUNTY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1623	2202	1
MANUFACTURING, MOORE	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - MANUFACTURING MOORE COUNTY	A	CONSTRUCTION FUNDING				1623	2202	2
MANUFACTURING, MOORE	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - MANUFACTURING MOORE COUNTY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1623	2202	3
MANUFACTURING, POTTER	A	DIRECT REUSE - POTTER COUNTY MANUFACTURING	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1638	918	1
MANUFACTURING, POTTER	A	DIRECT REUSE - POTTER COUNTY MANUFACTURING	A	CONSTRUCTION FUNDING				1638	918	2
MANUFACTURING, POTTER	A	DIRECT REUSE - POTTER COUNTY MANUFACTURING	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1638	918	3
MANUFACTURING, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1640	731	1
MANUFACTURING, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING	A	CONSTRUCTION FUNDING				1640	731	2
MANUFACTURING, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1640	731	3
MCLEAN	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1703	829	1
MCLEAN	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	A	CONSTRUCTION FUNDING				1703	829	2
MCLEAN	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1703	829	3
MCLEAN	A	MUNICIPAL CONSERVATION - MCLEAN	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1703	783	1
MCLEAN	A	MUNICIPAL CONSERVATION - MCLEAN	A	CONSTRUCTION FUNDING				1703	783	2
MCLEAN	A	MUNICIPAL CONSERVATION - MCLEAN	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1703	783	3
MEMPHIS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1709	900	1
MEMPHIS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	A	CONSTRUCTION FUNDING				1709	900	2
MEMPHIS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1709	900	3
MEMPHIS	A	MUNICIPAL CONSERVATION - MEMPHIS	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1709	784	1
MEMPHIS	A	MUNICIPAL CONSERVATION - MEMPHIS	A	CONSTRUCTION FUNDING				1709	784	2
MEMPHIS	A	MUNICIPAL CONSERVATION - MEMPHIS	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1709	784	3
MIAMI	A	MUNICIPAL CONSERVATION - MIAMI	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				1717	785	1
MIAMI	A	MUNICIPAL CONSERVATION - MIAMI	A	CONSTRUCTION FUNDING				1717	785	2
MIAMI	A	MUNICIPAL CONSERVATION - MIAMI	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				1717	785	3
PAMPA	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2045	828	1
PAMPA	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	A	CONSTRUCTION FUNDING				2045	828	2
PAMPA	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2045	828	3
PANHANDLE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2046	897	1
PANHANDLE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	A	CONSTRUCTION FUNDING				2046	897	2
PANHANDLE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2046	897	3
PANHANDLE	A	MUNICIPAL CONSERVATION - PANHANDLE	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2046	786	1
PANHANDLE	A	MUNICIPAL CONSERVATION - PANHANDLE	A	CONSTRUCTION FUNDING				2046	786	2
PANHANDLE	A	MUNICIPAL CONSERVATION - PANHANDLE	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2046	786	3
PERRYTON	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$2,114,200.00	2020		2063	736	1
PERRYTON	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	A	CONSTRUCTION FUNDING	$8,469,900.00	2022		2063	736	2
PERRYTON	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			2063	736	3
SHAMROCK	A	MUNICIPAL CONSERVATION - SHAMROCK	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2205	787	1
SHAMROCK	A	MUNICIPAL CONSERVATION - SHAMROCK	A	CONSTRUCTION FUNDING				2205	787	2
SHAMROCK	A	MUNICIPAL CONSERVATION - SHAMROCK	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2205	787	3
SPEARMAN	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2239	772	1
SPEARMAN	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	A	CONSTRUCTION FUNDING				2239	772	2
SPEARMAN	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2239	772	3
STINNETT	A	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2334	771	1
STINNETT	A	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	A	CONSTRUCTION FUNDING				2334	771	2
STINNETT	A	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2334	771	3

PWPA INFRASTRUCTURE FINANCING SURVEY RESULTS

SponsorEntityName	SponsorEntity PrimaryRegion	ProjectName	WMSProject SponsorRegion	IFRElementName	IFRElementValue	YearOfNeed	IFRProject DataId	EntityRwpId	WMSProjectId	IFRProject ElementsId
STINNETT	A	MUNICIPAL CONSERVATION - STINNETT	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2334	788	1
STINNETT	A	MUNICIPAL CONSERVATION - STINNETT	A	CONSTRUCTION FUNDING				2334	788	2
STINNETT	A	MUNICIPAL CONSERVATION - STINNETT	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2334	788	3
STRATFORD	A	MUNICIPAL CONSERVATION - STRATFORD	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2336	789	1
STRATFORD	A	MUNICIPAL CONSERVATION - STRATFORD	A	CONSTRUCTION FUNDING				2336	789	2
STRATFORD	A	MUNICIPAL CONSERVATION - STRATFORD	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2336	789	3
SUNRAY	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2345	739	1
SUNRAY	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	A	CONSTRUCTION FUNDING				2345	739	2
SUNRAY	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2345	739	3
SUNRAY	A	MUNICIPAL CONSERVATION - SUNRAY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2345	790	1
SUNRAY	A	MUNICIPAL CONSERVATION - SUNRAY	A	CONSTRUCTION FUNDING				2345	790	2
SUNRAY	A	MUNICIPAL CONSERVATION - SUNRAY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2345	790	3
TCW SUPPLY INC	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2356	770	1
TCW SUPPLY INC	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	A	CONSTRUCTION FUNDING				2356	770	2
TCW SUPPLY INC	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2356	770	3
TCW SUPPLY INC	A	MUNICIPAL CONSERVATION - TCW SUPPLY	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2356	791	1
TCW SUPPLY INC	A	MUNICIPAL CONSERVATION - TCW SUPPLY	A	CONSTRUCTION FUNDING				2356	791	2
TCW SUPPLY INC	A	MUNICIPAL CONSERVATION - TCW SUPPLY	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2356	791	3
TEXLINE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2362	830	1
TEXLINE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	A	CONSTRUCTION FUNDING				2362	830	2
TEXLINE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2362	830	3
TEXLINE	A	MUNICIPAL CONSERVATION - TEXLINE	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2362	792	1
TEXLINE	A	MUNICIPAL CONSERVATION - TEXLINE	A	CONSTRUCTION FUNDING				2362	792	2
TEXLINE	A	MUNICIPAL CONSERVATION - TEXLINE	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2362	792	3
VEGA	A	MUNICIPAL CONSERVATION - VEGA	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2406	793	1
VEGA	A	MUNICIPAL CONSERVATION - VEGA	A	CONSTRUCTION FUNDING				2406	793	2
VEGA	A	MUNICIPAL CONSERVATION - VEGA	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2406	793	3
WELLINGTON	A	ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$679,700.00	2015		2426	899	1
WELLINGTON	A	ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	A	CONSTRUCTION FUNDING	$3,000,000.00	2017		2426	899	2
WELLINGTON	A	ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			2426	899	3
WELLINGTON	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$1,000,000.00	2015		2426	898	1
WELLINGTON	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	A	CONSTRUCTION FUNDING	$1,589,800.00	2018		2426	898	2
WELLINGTON	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			2426	898	3
WELLINGTON	A	MUNICIPAL CONSERVATION - WELLINGTON	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$533,900.00	2015		2426	794	1
WELLINGTON	A	MUNICIPAL CONSERVATION - WELLINGTON	A	CONSTRUCTION FUNDING	$1,000,000.00			2426	794	2
WELLINGTON	A	MUNICIPAL CONSERVATION - WELLINGTON	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	0			2426	794	3
WHEELER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2445	730	1
WHEELER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	A	CONSTRUCTION FUNDING				2445	730	2
WHEELER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2445	730	3
WHITE DEER	A	MUNICIPAL CONSERVATION - WHITE DEER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING				2447	795	1
WHITE DEER	A	MUNICIPAL CONSERVATION - WHITE DEER	A	CONSTRUCTION FUNDING				2447	795	2
WHITE DEER	A	MUNICIPAL CONSERVATION - WHITE DEER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY				2447	795	3
WHEELER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	A	PLANNING, DESIGN, PERMITTING & ACQUISITION FUNDING	$698,900.00	2017				1
WHEELER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	A	CONSTRUCTION FUNDING	$2,096,700.00	2017				2
WHEELER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	A	PERCENT STATE PARTICIPATION IN OWNING EXCESS CAPACITY	$0.00					3

Appendix I

Comments Received on the IPP and Responses

TEXAS PARKS & WILDLIFE

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August 14, 2015

Mr. Kyle G. Ingham, Local Government Services Director
Panhandle Regional Water Planning Group
P.O. Box 9257
Amarillo, TX 79105

Re: 2016 Panhandle Region A Initially Prepared Plan

Thank you for seeking review and comment from the Texas Parks and Wildlife Department ("TPWD") on the 2016 Initially Prepared Regional Water Plan for the Panhandle Water Planning Group (PWPA) Region A (IPP). As you know, water impacts every aspect of TPWD's mission to manage and conserve the natural and cultural resources of Texas. As the agency charged with primary responsibility for protecting the state's fish and wildlife resources, TPWD is positioned to provide technical assistance during the water planning process. Although TPWD has limited regulatory authority over the use of state waters, TPWD is committed to working with stakeholders and others to provide science-based information during the water planning process intended to avoid or minimize impacts to state fish and wildlife resources.

TPWD understands that regional water planning groups are guided by 31 TAC §357 when preparing regional water plans. These water planning rules spell out requirements related to natural resource and environmental protection. Accordingly, TPWD staff reviewed the IPP with a focus on the following questions:

- Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
- Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the IPP discuss how these threats will be addressed?
- Does the IPP describe how it is consistent with long-term protection of natural resources?
- Does the IPP include water conservation as a water management strategy?
- Does the IPP include Drought Contingency Plans?
- Does the IPP recommend any stream segments be nominated as ecologically unique?
- If the IPP includes strategies identified in the 2010 regional water plan, does it address concerns raised by TPWD in connection with the 2010 Water Plan.

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.texas.gov

The population of the 21 counties that comprise the Panhandle Regional Water Planning Area (PWPA) was 380,733 in 2010 and is expected to increase to 639,220 by 2070. Projected water demands are about 1.7 million acre feet in 2020, decreasing to about 1.16 million acre-feet in 2070. The decline in demands is due in part to declining groundwater availability in the region but also due to increased irrigation efficiency and water conservation measures. The region's largest water demand is for irrigated agriculture (87 percent), followed by municipal demand (5 percent).

The PWPA is located within portions of the Canadian River Basin and Red River Basin. In 2010, only two percent of the total water use in the PWPA came from surface water sources. There are three major reservoirs in the PWPA: Lake Meredith, Palo Duro Reservoir, and Greenbelt Reservoir. Groundwater sources in the PWPA include the Ogallala, Seymour, Blaine, Dockum, and Rita Blanca aquifers The Ogallala aquifer constitutes 90% of the total groundwater availability in the PWPA.

The PWPA IPP provides brief descriptions of natural resources in the region including vegetation types, soils, wetlands, aquatic resources, springs, wildlife and endangered/threatened species. A good discussion of the importance of playa basins is included in the IPP. In addition to their biological importance as wetlands, playas also provide local recharge to the Ogallala aquifer. The IPP states that environmental impacts and the protection of the region's resources were a priority in the water management strategies selection process, and potential impacts to sensitive environmental factors were considered for each strategy.

Water-related threats to natural resources, primarily insufficient groundwater and water quality concerns, are also described in the IPP. Surface and groundwater development as well as brush encroachment have altered natural stream flow patterns in the PWPA. In addition, spring flows have declined over the past several decades. Irrigation water conservation strategies are intended to help address this problem. However, according to the IPP, continued depletion of the local aquifers will likely continue to impact base flows of local streams and rivers in the PWPA. Salt cedar removal in the Lake Meredith watershed is a recommended strategy to increase flow into the Canadian River, improve water quality, and improve habitat. The North American Waterfowl Management Joint Venture is discussed as a means of protecting playas as wildlife habitat.

Water conservation and drought management, wastewater reuse, expanded use of existing supplies, new groundwater development, precipitation enhancement and brush control are recommended strategies for meeting future water needs. Drought contingency plans are also included in the IPP. The planning group has proposed water conservation strategies for all municipal and irrigation water users. As appropriate all municipal users are encouraged to reduce per capita water use to achieve the Texas Water Conservation Task Force goal of 140 gallons per person per day (gpcd). Even though conservation is expected to provide 488,165 acre-feet per year of water savings by 2070, the average gpcd for the PWPA is projected to be 195 in 2020, slowly declining to around 170 by 2070.

TPWD supports the planning group's consideration of brush control/management as an additional means of conserving water if done in a manner that can also benefit wildlife habitat. TPWD also supports the inclusion of reuse of treated municipal effluent for meeting future water needs however consideration should be given to the impact reduced return flows will have on water bodies like the Prairie Dog Town Fork of the Red River. In addition, disposal of brine concentrate from reverse osmosis treatment associated with direct potable reuse projects may have impacts to aquatic ecosystems if not disposed of properly.

The IPP includes a quantitative reporting of environmental factors (Attachment 5-3), scoring impacts on a scale of 1-5, where 5 is no or positive impact and 1 is highest impact. Narrative descriptions are given for several strategies that may have impacts, noting detailed evaluations will be performed if needed once project details are identified. Where appropriate potential impacts to spring flows, spring ecosystems and playa lakes should be identified, especially where these features continue to support fish and wildlife.

TPWD notes that the plan does not recommend nomination of any stream segments as ecologically unique. TPWD has identified several stream segments in the region that meet at least one of the criteria for classification as ecologically unique should the regional planning group decide to pursue nomination of an ecologically significant stream in the future. We are happy to assist the regional planning group should they elect to go in this direction.

Thank you for your consideration of these comments. TPWD looks forward to continuing to work with the planning group to develop water supply strategies that not only meet the future water supply needs of the region but also preserve the ecological health of the region's aquatic resources. Please contact Cindy Loeffler at (512) 389-8715 if you have any questions or comments.

Sincerely,

Ross Melinchuk,
Deputy Executive Director, Natural Resources

RM: CL:ms

cc: Craig Bonds, Division Director, Inland Fisheries Division, TPWD
Charlie Munger, Inland Fisheries Division, TPWD

Texas Water
Development Board
P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

July 21, 2015

Mr. C.E. Williams, Chair
Panhandle Regional Water Planning Group
c/o Panhandle GCD
P.O. Box 637
White Deer, Texas 79097

Mr. Kyle Ingham
Panhandle Regional Planning Commission
415 SW 8th Ave
Amarillo, Texas 79101

Re: Texas Water Development Board Comments on the Panhandle Regional Water Planning Group (Region A) Initially Prepared Plan, Contract No. 1148301312

Dear Mr. Williams and Mr. Ingham:

Texas Water Development Board (TWDB) staff completed a review of the Initially Prepared Plan (IPP) submitted by May 1, 2015 on behalf of the Region A Regional Water Planning Group. The attached comments follow this format:

- **Level 1:** Comments, questions, and online regional water planning database revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements; and,

- **Level 2:** Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

The TWDB's statutory requirement for review of potential interregional conflicts under Title 31 Texas Administrative Code (TAC) §357.62 will not be completed until submittal and review of adopted regional water plans. However, as previously requested by our Executive Administrator, please inform TWDB in advance of your final plan if your planning group believes that an interregional conflict exists. Additionally, subsequent review will be performed as the planning group completes its data entry into the regional water planning database (DB17). If issues arise during our ongoing data review, they will be communicated promptly to the planning group to resolve.

Title 31 TAC§357.50(d) requires the regional water planning group to consider timely agency and public comment. Section 357.50(e) requires the final adopted plan include summaries of all timely written and oral comments received, along with a response explaining any resulting revisions or why changes are not warranted. Copies of TWDB's Level 1 and 2 written comments and the region's responses must be included in the final, adopted regional water plan. While the comments included in this letter represent TWDB's review to date, please anticipate the need to respond to additional comments regarding data integrity, including any water source overallocations, in the regional water planning database (DB17) once data entry is completed by the region.

Standard to all planning groups is the need to include certain content in the final regional water plans that was not yet available at the time that IPPs were prepared and submitted. In your final regional water plan, however please be sure to also incorporate the following:

a) Completed results from the regional planning group's infrastructure financing survey (IFR) for sponsors of recommended projects with capital costs *[31 TAC §357.44]*;
b) Completed results from the implementation survey *[31 TAC §357.45(a)]*;
c) The socioeconomic impact evaluation provided by TWDB at the request of the planning group *[31 TAC §357.33(c)]*;
d) Documentation that comments received on the IPP were considered in the development of the final plan *[31 TAC §357.50(d)]*;
e) Evidence, such as a certification, that the final, adopted regional water plan is complete and adopted by the planning group *[31 TAC §357.50(j)(1)]*; and,
f) The required DB17 reports, as made available by TWDB, in the executive summary or elsewhere in the plan as specified in the Contract *[31 TAC §357.50(e)(2)(B), Contract Scope of Work Task 4D(p), Contract Exhibit 'C', Table 2]*. Please ensure that the numerical values presented in the tables throughout the final, adopted regional water plan are consistent with the data provided in DB17. For the purpose of development of the 2017 State Water Plan, water management strategy and other data entered by the regional water group in DB17 (and as presented in the regional plan) shall take precedence over any conflicting data presented in the final regional water plan *[Contract Exhibit 'C', Sections 12.1.3. and 12.2.2]*.

The following items must accompany, separately, the submission of the final, adopted regional water plan:

- The prioritized list of all recommended projects in the regional water plan *[Texas Water Code 15.436(a), Contract Scope of Work Task 13]*; and,
- Any remaining hydrologic modeling files or GIS files that may not have been provided at the time of the submission of the IPP but that were used in developing the final plan. *[31 TAC §357.50(e)(2)(C), Contract Exhibit 'C', Section 12.2.1; Contract Scope of Work Task 3-III-13]*

Note that provision of certain content in an electronic-only form is permissible as follows: Internet links are permissible as a method for including model conservation and drought contingency plans within the final regional water plan; hydrologic modeling files may be submitted as electronic appendices, however all other regional water plan appendices should be incorporated in hard copy format within each plan *[31 TAC §357.50(e)(2)(C), Contract Scope of Work Task 5e, Contract Exhibit 'C', Section 12.2.1]*.

The following general requirements that apply to recommended water management strategies must be adhered to in all final regional water plans including:

- Regional water plans must not include any strategies or costs that are associated with simply maintaining existing water supplies or replacing existing infrastructure. Plans may include only infrastructure costs that are associated with volumetric increases of treated water supplies delivered to water user groups or that result in more efficient use of existing supplies *[31 TAC §357.10(28), §357.34(d)(3)(A), Contract Exhibit 'C", Section 5.1.2.2, Section 5.1.2.3]*; and,
- Regional water plans must not include any retail distribution-level infrastructure costs (other than those costs related to conservation strategies such as water loss reduction) *[31 TAC §357.10(28), §357.34(d)(3)(A), Contract Exhibit 'C", Section 5.1.2.3]*.

To facilitate efficient and timely completion, and Board approval, of your final regional water plan, please provide your TWDB project manager with early drafts of your responses to these IPP comments for preliminary review and feedback.

If you have any questions regarding these comments or would like to discuss your approach to addressing any of these comments, please do not hesitate to contact Sarah Backhouse at (512) 936-2387. TWDB staff will be available to assist you in any way possible to ensure successful completion of your final regional water plan.

Sincerely,

Jeff Walker
Deputy Executive Administrator
Water Supply and Infrastructure

Attachments

cc w/att: Ms. Simone Kiel, Freese & Nichols, Inc.

TWDB Comments on the Initially Prepared 2016 Panhandle (Region A) Regional Water Plan

Level 1: Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

1. Sections 5B.1 and 5B.2: For the municipal and irrigation conservation strategies, please specify the volume of water associated with each component of these strategies that have a capital cost in the final, adopted regional water plan. *[Contract Exhibit 'D', Section 5.4]*

2. Please provide a statement regarding any water availability requirements promulgated by a county commissioners court pursuant to Texas Water Code §35.109, which in Region A applies to the Dallam County Priority Groundwater Management Area. *[31 Texas Administrative Code (TAC) §357.22(a)(6)]*

3. Please indicate how the planning group considered the regionalization of water and wastewater services in the final, adopted regional water plan. *[31 TAC §357.22 (a)(10)]*

4. Section 2.7: The plan does not include projected demands associated with each wholesale water provider (WWP), by category of water use and county and river basin splits. Please include WWP demands in the final, adopted regional water plan. *[31 TAC §357.31(b)(d)]*

5. Section 2.7: It is not clear whether the plan presents the current contractual obligations of WWPs. Please include WWP contractual obligations in the final, adopted regional water plan. *[31 TAC §357.31 (c)]*

6. Please include a summary of the municipal demand savings due to plumbing fixture requirements (as previously provided by TWDB) in the final, adopted regional water plan. *[31 TAC §357.31(d)]*

7. The plan does not appear to include projected needs associated with each WWP, by category of use and county and river basin splits. Please include WWP needs in the final, adopted regional water plan. *[31 TAC §357.33 (b),(d)]*

8. Section 5D.5.1, pages 5-69, 5-70; and Section 5D.8.2, pages 5-85, 5-86: The plan appears to include water management strategies with treatment infrastructure that does not increase the volume of supply to water user groups. For example Nitrate Treatment for the City of Wellington and Nitrate Removal for the City of Lakeview. Regional water plans must not include any strategies or costs that are associated with simply maintaining existing water supplies or replacing infrastructure. Plans may include only infrastructure costs that are associated with volumetric increases of treated water supplies delivered to water user groups or that result in more efficient use of existing supplies. Please revise as appropriate throughout the final, adopted regional water plan. *[Contract Exhibit 'C', Sections 5.1.2.2 and 5.1.2.3]*

9. Section 5C.1.3, page 5-40 and Table 5C-2, page 5-41: The conjunctive use water management strategy appears to be combined with a brush management strategy. Unless the projects are directly interdependent, and reflected as such in DB17, each project and strategy must be associated with volumes of water provided by a single strategy type and should not be lumped together with other types of strategies. Strategy types must remain independent of one another for purposes of accounting of water availability, to reflect implementation, and to facilitate project prioritizations. Please revise as appropriate throughout the final, adopted regional water plan. *[31 TAC 357.34 (e); Contract Exhibit 'D', Section 5.3]*

10. Page ES-10, 5-40: Table ES-6 notes that costs for brush control were not calculated on an acre-feet per year basis and instead presents an annual cost for the strategy, as referenced on page 5-40, in unit costs column. Please present the unit cost of the strategy in the final, adopted regional plan. A footnote may be added to Table ES-6 to note the annual cost. *[31 TAC §357.34 (d)(2), Contract Exhibit 'C', Section 5.1.2]*

11. Table ES-6 and Sections 5D.12.4, 5D.13.2, and 5D.14.5: Please specify a quantified volume of water supply for the following strategies if they are to be included in the recommended water management strategy table: Manufacturing, Hutchinson: Purchase from Borger; Manufacturing, Lipscomb: Purchase from Booker; and Manufacturing, Moore: Purchase from Cactus. *[31 TAC 357.34 (d)(3)(A)]*

12. The plan in some instances, does not appear to include a quantitative reporting of environmental factors. For example: pages 5-40 and 5-45 provide qualitative descriptions as "concern" about habitat and "low" impacts, respectively, but the plan does not appear to include quantification of the impacts. Additionally, Attachment 5-3 presents a numeric scoring system but it is unclear if the scoring system is based upon quantitative data. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC 357.34 (d)(3)(B)]*

13. The plan in some instances, does not appear to include a quantitative reporting of impacts to agricultural resources. For example, page 5-45 provides a qualitative description as "low impact on agriculture" but does not appear to include quantification of the non-zero impact. Additionally, Attachment 5-2 presents a numeric, qualitative scoring system but it is unclear if the scoring system is based upon quantitative data. Please include quantitative reporting of impacts to agricultural resources in the final, adopted regional water plan. *[31 TAC 357.34 (d)(3)(C)]*

14. Chapter 7: The plan does not provide a general description of the local drought contingency plans that involve making emergency connections between water systems or wholesale systems. Please include these descriptions of local drought contingency plans, if any, in the final, adopted regional water plan or, if no local drought contingency plans involve making emergency connections, please indicate so in the final, adopted regional water plan. *[31 TAC §357.42 (e)]*

15. Section 11.2.7, page 11-11: The plan does not include a summary of how identified water needs for WWPs differ from the 2011 regional water plan. Please include summary in the final, adopted regional water plan. *[31 TAC §357.45 (b)(3)]*

16. The plan does not appear to include a listing of the water rights that are the basis for the surface water availability in the plan. Please include such a listing in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.1]*

17. Page 3-17, Table 3-10: Please clarify how the run-of-river availabilities were calculated for municipal water users to ensure that all monthly demands are fully met for the entire simulation of the unmodified WAM Run 3 in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.4]*

18. The technical evaluations of the water management strategies do not appear to estimate water losses from the associated strategies. Please include an estimate of water losses in the final, adopted regional water plan, for example in a format of an estimated percent loss. *[31 TAC §357.34(d)(3)(A); Contract Exhibit 'C', Section 5.1.1]*

Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

1. Table ES-2, page ES-5 and Table 3-15, page 3-25: The DB17 source availability report shows Palo Duro Reservoir to have an availability volume ranging from 3,917 AFY through 3,708 AFY over the planning horizon but the referenced tables (Tables ES-2 and 3-15) show this availability as zero. Please reflect the DB17 availability numbers in these tables and throughout the plan as appropriate.

2. Table 3-21, page 3-33. Please consider relabeling the decade table headers. Decade 2020 is labeled twice, therefore the table header does not include the decade 2070.

3. Table 4-1, page 4-2. The supply volumes shown in Table 4-1 do not match the total existing supply from DB17 in all decades. For example, 2030 supply in Table 4-1 is 1,450,997 AFY compared to the 2030 value in the existing water supply report of 1,451,002 AFY. Please consider revising accordingly.

4. Page 5-41, Table 5C-2: The plan does not present strategy supply volumes for CRMWA conservation strategies for Region O Customers presented in Table 5C-2. Please consider including the conservation information for Region O customers in final, adopted regional water plan, or consider including a footnote that this information can be found in the Region O plan.

5. Section 5C.2.4, Pages 5-46 through 5-47: The "Impact on Water Resources and other Management strategies" subsection states that the direct potable reuse could impact the amount of direct non-potable reuse currently being made available in Potter County for steam electric and potentially for manufacturing. Please consider providing volumes to quantify the impact in the final, adopted regional water plan. For example, quantify the

volume of wastewater discharge from Amarillo and its associated allocations (direct potable reuse, steam electric power generation, and manufacturing).

6. Chapter 7: Please consider including more detailed information on drought triggers and actions from current drought contingency plans by entity in the final, adopted regional water plan.

7. Table 7-5: Given that County-Other sub-water user groups (WUG) are presented in the potential emergency response analysis, please clarify whether all entities in the County-Other WUG are represented. If not, please consider including an analysis for the remainder of the County-Other population, by County, in the final, adopted regional water plan.

TWDB Comments on the Initially Prepared 2016 Panhandle (Region A) Regional Water Plan

Level 1: Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

1. Sections 5B.1 and 5B.2: For the municipal and irrigation conservation strategies, please specify the volume of water associated with each component of these strategies that have a capital cost in the final, adopted regional water plan. *[Contract Exhibit 'D', Section 5.4]*

   The volume of water associated with a capital cost is detailed in the data tables in Appendix K. The text in Section 5B.1.3 was modified to show that the capital costs for municipal conservation are associated with leak detection and repair. A footnote was also added to Table 5B-9 that states the capital costs shown for the irrigation combination strategy is associated with irrigation equipment changes.

2. Please provide a statement regarding any water availability requirements promulgated by a county commissioners court pursuant to Texas Water Code §35.109, which in Region A applies to the Dallam County Priority Groundwater Management Area. *[31 Texas Administrative Code (TAC) §357.22(a)(6)]*

   A discussion on Priority Groundwater Management Areas (PGMA) was added to Section 1.5.1, Groundwater Regulation. As of 2012, all of the area within the Dallam County PGMA has been incorporated into the North Plains GCD. Therefore, regulation of groundwater within the previously designated Dallam County PGMA is promulgated by the North Plains GCD. To our knowledge, no additional regulation has been promulgated by the Dallam County Commissioner's Court. This statement was added to Section 1.5.1.

3. Please indicate how the planning group considered the regionalization of water and wastewater services in the final, adopted regional water plan. *[31 TAC §357.22 (a)(10)]*

   A statement was added in Chapter 5A indicating that where appropriate, regional strategies to supply water were considered. The PWPG did not consider regionalization of wastewater services since regional water planning focuses on water supply needs, not wastewater needs.

4. Section 2.7: The plan does not include projected demands associated with each wholesale water provider (WWP), by category of water use and county and river basin splits. Please include WWP demands in the final, adopted regional water plan. *[31 TAC §357.31(b)(d)]*

   The details of the wholesale water provider demands are included in the data reports in Appendix K of the plan.

5. Section 2.7: It is not clear whether the plan presents the current contractual obligations of WWPs. Please include WWP contractual obligations in the final, adopted regional water plan. *[31 TAC §357.31 (c)]*

   A statement was added to Section 2.7 that clarifies the demands represent the current contract obligations and expected future demands of existing customers. This was developed with input by the wholesale water provider and is truly representative of the demand on the wholesale water provider in the PWPA. To only include current contract obligations does not represent the intent of the provider or customer. Many of the providers are obligated to meet their customers' water needs without a contract limit. Also, the PWPG does not have copies of the contracts to provide this information.

6. Please include a summary of the municipal demand savings due to plumbing fixture requirements (as previously provided by TWDB) in the final, adopted regional water plan. *[31 TAC §357.31(d)]*

   A new table was added to Chapter 2 that shows the municipal demand savings due to plumbing fixtures by county.

7. The plan does not appear to include projected needs associated with each WWP, by category of use and county and river basin splits. Please include WWP needs in the final, adopted regional water plan. *[31 TAC §357.33 (b),(d)]*

   The details of the wholesale water provider needs are included in the data reports in Appendix K of the plan.

8. Section 5D.5.1, pages 5-69, 5-70; and Section 5D.8.2, pages 5-85, 5-86: The plan appears to include water management strategies with treatment infrastructure that does not increase the volume of supply to water user groups. For example Nitrate Treatment for the City of Wellington and Nitrate Removal for the City of Lakeview. Regional water plans must not include any strategies or costs that are associated with simply maintaining existing water supplies or replacing infrastructure. Plans may include only infrastructure costs that are associated with volumetric increases of treated water supplies delivered to water user groups or that result in more efficient use of existing supplies. Please revise as appropriate throughout the final, adopted regional water plan. *[Contract Exhibit 'C', Sections 5.1.2.2 and 5.1.2.3]*

   The strategies for the cities of Wellington and Lakeview are included in the PWPA water plan because the current supplies do not meet federal drinking water standards for nitrate. To better represent this water quality limitation, the current supplies for these entities is now shown as zero (0) due to water quality limitations. The strategies are retained in the final plan and shown with the appropriate volume of water to meet the entity's water needs. Appropriate changes were made to Chapters 3 and 5.

9. Section 5C.1.3, page 5-40 and Table 5C-2, page 5-41: The conjunctive use water management strategy appears to be combined with a brush management strategy. Unless the projects are directly interdependent, and reflected as such in DB17, each project and strategy must be associated with volumes of water provided by a single strategy type and

should not be lumped together with other types of strategies. Strategy types must remain independent of one another for purposes of accounting of water availability, to reflect implementation, and to facilitate project prioritizations. Please revise as appropriate throughout the final, adopted regional water plan. *[31 TAC 357.34 (e); Contract Exhibit 'D', Section 5.3]*

The conjunctive use strategy and brush control are interdependent strategies for CRMWA. Under drought of record conditions, brush control has no supply. This is also the assumption for Lake Meredith for planning purposes (the drought of record is on-going). However, used conjunctively with CRMWA's groundwater sources, water is made available in Lake Meredith through brush control and periodic inflows to Lake Meredith. The strategy is conjunctive use, and brush control is a project component of that strategy. In addition, aquifer storage and recoovery was also added to the conjunctive use strategy as a project component. This project would be used to storage water made available under conjunctive use. This is how the project is currently represented in the state's database (DB17). Where appropriate, clarifications were made in the plan to reflect this interdependent relationship.

10. Page ES-10, 5-40: Table ES-6 notes that costs for brush control were not calculated on an acre-feet per year basis and instead presents an annual cost for the strategy, as referenced on page 5-40, in unit costs column. Please present the unit cost of the strategy in the final, adopted regional plan. A footnote may be added to Table ES-6 to note the annual cost. *[31 TAC §357.34 (d)(2), Contract Exhibit 'C', Section 5.1.2]*

    The costs were modified to represent the conjunctive use strategy that includes brush control.

11. Table ES-6 and Sections 5D.12.4, 5D.13.2, and 5D.14.5: Please specify a quantified volume of water supply for the following strategies if they are to be included in the recommended water management strategy table: Manufacturing, Hutchinson: Purchase from Borger; Manufacturing, Lipscomb: Purchase from Booker; and Manufacturing, Moore: Purchase from Cactus. *[31 TAC 357.34 (d)(3)(A)]*

    The purchase of water from a water supplier is associated with supplies developed by the provider. These strategies were removed from Table ES-6. No changes were made to Subchapter 5D. Details of the supply amounts to customers of water suppliers are included in the database reports in Appendix K of the plan.

12. The plan in some instances, does not appear to include a quantitative reporting of environmental factors. For example: pages 5-40 and 5-45 provide qualitative descriptions as "concern" about habitat and "low" impacts, respectively, but the plan does not appear to include quantification of the impacts. Additionally, Attachment 5-3 presents a numeric scoring system but it is unclear if the scoring system is based upon quantitative data. Please include quantitative reporting in the final, adopted regional water plan. *[31 TAC 357.34 (d)(3)(B)]*

An explanation of the quantitative reporting of impacts was added to Attachment 5-3, Evaluation Matrix. Where appropriate, elaboration of impacts in the discussions in Chapter 5 was added. In many cases, there are no data available on quantifiable impacts. Therefore, assumptions were made that may or may not result in reasonable estimates of quantifiable impacts. Actual impacts will be developed during the design of the project, which is beyond the scope of regional water planning.

13. The plan in some instances, does not appear to include a quantitative reporting of impacts to agricultural resources. For example, page 5-45 provides a qualitative description as "low impact on agriculture" but does not appear to include quantification of the non-zero impact. Additionally, Attachment 5-2 presents a numeric, qualitative scoring system but it is unclear if the scoring system is based upon quantitative data. Please include quantitative reporting of impacts to agricultural resources in the final, adopted regional water plan. *[31 TAC 357.34 (d)(3)(C)]*

    An explanation of the quantitative reporting of impacts was added to Attachment 5-3, Evaluation Matrix. Where appropriate, elaboration of impacts in the discussions in Chapter 5 was added. In many cases, there are no data available on quantifiable impacts. Therefore, assumptions were made that may or may not result in reasonable estimates of quantifiable impacts. Actual impacts will be developed during the design of the project, which is beyond the scope of regional water planning.

14. Chapter 7: The plan does not provide a general description of the local drought contingency plans that involve making emergency connections between water systems or wholesale systems. Please include these descriptions of local drought contingency plans, if any, in the final, adopted regional water plan or, if no local drought contingency plans involve making emergency connections, please indicate so in the final, adopted regional water plan. *[31 TAC §357.42 (e)]*

    Existing emergency connections are discussed in Section 7.3.1. The PWPG did not receive any local drought contingency plans that specified emergency connections in response to drought. A summary of the local drought contingency plans was added as an attachment to Chapter 7.

15. Section 11.2.7, page 11-11: The plan does not include a summary of how identified water needs for WWPs differ from the 2011 regional water plan. Please include summary in the final, adopted regional water plan. *[31 TAC §357.45 (b)(3)]*

    A summary of how identified water needs for wholesale water providers in the 2016 water plan differ from the 2011 regional water plan was added to Chapter 11.

16. The plan does not appear to include a listing of the water rights that are the basis for the surface water availability in the plan. Please include such a listing in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.1]*

    A listing of water rights was added to the Appendix C, WAM Analysis for PWPA Water Availability. A reference to this information was added to Chapter 3.

17. Page 3-17, Table 3-10: Please clarify how the run-of-river availabilities were calculated for municipal water users to ensure that all monthly demands are fully met for the entire simulation of the unmodified WAM Run 3 in the final, adopted regional water plan. *[Contract Exhibit 'C', Section 3.4]*

    Additional documentation of how the run-of-river availabilities were calculated was added to Appendix C.

18. The technical evaluations of the water management strategies do not appear to estimate water losses from the associated strategies. Please include an estimate of water losses in the final, adopted regional water plan, for example in a format of an estimated percent loss. *[31 TAC §357.34(d)(3)(A); Contract Exhibit 'C', Section 5.1.1]*

    The assumptions that were used to estimate of the water losses associated with strategies were added to the discussion in Chapter 5A.

Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional water plan.

1. Table ES-2, page ES-5 and Table 3-15, page 3-25: The DB17 source availability report shows Palo Duro Reservoir to have an availability volume ranging from 3,917 AFY through 3,708 AFY over the planning horizon but the referenced tables (Tables ES-2 and 3-15) show this availability as zero. Please reflect the DB17 availability numbers in these tables and throughout the plan as appropriate.

    The availability values shown in DB17 were documented in the referenced tables with a footnote that clarifies there is no infrastructure to access these supplies.

2. Table 3-21, page 3-33. Please consider relabeling the decade table headers. Decade 2020 is labeled twice, therefore the table header does not include the decade 2070.

    The decade table headers were relabeled.

3. Table 4-1, page 4-2. The supply volumes shown in Table 4-1 do not match the total existing supply from DB17 in all decades. For example, 2030 supply in Table 4-1 is 1,450,997 AFY compared to the 2030 value in the existing water supply report of 1,451,002 AFY. Please consider revising accordingly.

    The final numbers in the plan were reviewed and updated, as needed, to match the values reported from DB17 in all decades. Where there were rounding differences, no changes were made.

4. Page 5-41, Table 5C-2: The plan does not present strategy supply volumes for CRMWA conservation strategies for Region O Customers presented in Table 5C-2. Please consider including the conservation information for Region O customers in final, adopted regional water plan, or consider including a footnote that this information can be found in the Region O plan.

The customer conservation for customers in the Llano Estacado Region (Region O) were added to Table 5C-2.

5. Section 5C.2.4, Pages 5-46 through 5-47: The "Impact on Water Resources and other Management strategies" subsection states that the direct potable reuse could impact the amount of direct non-potable reuse currently being made available in Potter County for steam electric and potentially for manufacturing. Please consider providing volumes to quantify the impact in the final, adopted regional water plan. For example, quantify the volume of wastewater discharge from Amarillo and its associated allocations (direct potable reuse, steam electric power generation, and manufacturing).

   Over time the expected amount of wastewater generated by Amarillo will increase. The city has a contract to sell all of its reuse to Xcel Energy. However, Xcel Energy is not using 100% of the available treated wastewater. The water demands developed by the TWDB show SEP demands increasing over time in Potter County. However, Xcel Energy does not plan to significantly increase its production and there are no other known SEP facilities planned for Potter County. The PWPA plan currently shows 100% of the SEP demand in Potter County being met by reuse purchased from Amarillo, but some of that reuse water is likely to be available to other manufacturers and/or Amarillo. There is potentially up to 10 MGD of reuse water available above the projected demands for steam electric power. More may be available if the projected SEP demands are low. However, it is uncertain whether this water can be contracted without consent of Xcel Energy. These considerations were added to the strategy descriptions.

6. Chapter 7: Please consider including more detailed information on drought triggers and actions from current drought contingency plans by entity in the final, adopted regional water plan.

   A summary of the local drought contingency plans was added as an attachment to Chapter 7, Attachment 7-2.

7. Table 7-5: Given that County-Other sub-water user groups (WUG) are presented in the potential emergency response analysis, please clarify whether all entities in the County-Other WUG are represented. If not, please consider including an analysis for the remainder of the County-Other population, by County, in the final, adopted regional water plan.

   A footnote was added to Table 7-5 to clarify the selection of entities listed under County-Other.

Appendix J

Implementation Survey

2011 Strategy Implementation Survey

Sponsor	Recommended Water Management Strategy	DBProjectId	CapitalCost	SS2010	SS2020	SS2030	SS2040	SS2050	SS2060	Y denotes strategies with supply volumes included in other strategies	Project Description	Infrastructure Type*	At what level of Implementation is the project?*	If not implemented, why?*	Initial Volume of Water Provided (acft/yr)	Funds Expended to Date ($)	Project Cost ($) (should include development and construction costs)	Year the Project is Online?*	Is this a phased project?*	(Phased) Ultimate Volume (acft/yr)	(Phased) Ultimate Project Cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Included in the 2016 Plan?*	Comments
AMARILLO	Municipal conservation	188	$0	0	1,375	2,453	2,639	2,841	3,012	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
AMARILLO	Potter County well field	814	$128,511,300	0	9,467	10,292	11,182	11,141	10,831	N	Phase 1 well field	Wells	Currently Operating		10000			2011	Yes	18000		2030	TWDB	Yes	Phase II included in the 2016 Plan; Supply amount limited by MAG
AMARILLO	Roberts County well field - Amarillo	630	$287,377,200	0	0	0	11,210	11,210	22,420	N	Develop wellfield	Wells	Not Implemented	Too soon										Yes	
BORGER	Drill additional groundwater well	194	$9,379,200	0	0	1,000	1,000	2,000	2,000	N	Develop wellfield	Wells	Under Construction					2015	No					Yes	Production wells, pipelines, pumps, and storage facilities have been constructed and the project should be on-line in 2015
BORGER	Municipal conservation	188	$0	0	24	71	114	107	102	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
CACTUS	Drill additional groundwater well	194	$10,893,400	500	1,500	1,500	3,000	3,000	3,000	N	Develop wellfield	Wells	Sponsor Has Taken Official Action to Initiate Project											Yes	
CACTUS	Municipal conservation	188	$0	0	18	31	31	31	31	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
CANADIAN RIVER MUNICIPAL WATER A	CRMWA acquisition of water rights	903	$88,200,000	0	0	0	0	0	0	N	Acquire additional water rights in Roberts County	No Infrastructure	All Phases Fully Implemented		0			2011	Yes	448333				No	See related project to develop infrastructure to use water rights
CANADIAN RIVER MUNICIPAL WATER A	CRMWA Roberts County well field	816	$21,824,000	0	0	15,000	15,000	15,000	15,000	N	Develop wellfield	Wells	Feasibility Study Ongoing											Yes	Phase II included in the 2016 Plan
CANYON	Drill additional groundwater well	194	$9,528,800	700	1,400	2,100	2,800	2,800	3,800	N	Develop wellfield	Wells	Under Construction					2015	Yes, but the Water Plan shows only 1 phase					Yes	
CANYON	Municipal conservation	188	$0	0	80	176	191	208	227	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
COUNTY-OTHER, HALL	Drill additional groundwater well	194	$2,522,400	150	150	150	200	200	200	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
COUNTY-OTHER, MOORE	Drill additional groundwater well	194	$3,114,800	0	0	500	500	1,000	1,000	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
COUNTY-OTHER, MOORE	Municipal conservation	188	$0	0	29	63	75	83	87	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
COUNTY-OTHER, MOORE	Voluntary transfers from other users	192	$0	0	0	50	100	100	100	Y	Purchase from Cactus, Dumas	Other	Not Implemented	Other										No	New groundwater wells to meet need in 2016 Plan
COUNTY-OTHER, POTTER	Drill additional groundwater well	194	$8,559,400	0	600	600	1,600	2,200	2,200	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
COUNTY-OTHER, POTTER	Municipal conservation	188	$0	0	69	143	174	209	236	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
COUNTY-OTHER, RANDALL	Drill additional groundwater well	194	$10,889,220	0	0	600	1,200	1,800	2,400	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
COUNTY-OTHER, RANDALL	Municipal conservation	188	$0	0	101	197	231	268	299	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
DUMAS	Drill additional groundwater well	194	$7,997,200	0	387	1,163	1,672	2,219	2,500	N	Develop wellfield	Wells	Sponsor Has Taken Official Action to Initiate Project		700				Yes	2500				Yes	Dumas has added new wells to its existing well fields. This project considers a new well field, which has not been initiated. The project in 2016 plan is larger.
DUMAS	Municipal conservation	188	$0	0	89	158	166	171	174	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
FRITCH	Drill additional groundwater well	194	$4,006,900	200	400	400	400	400	400	N	Develop wellfield	Wells	Not Implemented	Other										No	No longer a need in the 2016 Plan
GREENBELT MUNICIPAL & INDUSTRIAL	Drill additional groundwater well	194	$1,865,900	0	800	800	800	800	800	N	Develop wellfield	Wells	Not Implemented											Yes	GMIWA has constructed new wells near its lake. This strategy describes a larger well field in north Donley County, which has not been constructed.
GRUVER	Drill additional groundwater well	194	$1,968,500	0	350	350	350	350	350	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
GRUVER	Municipal conservation	188	$0	0	10	16	17	17	17	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, ARMSTRONG	Irrigation conservation	239	$0	0	2,170	2,251	2,397	2,478	2,558	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, ARMSTRONG	Precipitation enhancement	815	$0	0	785	785	785	785	785	N	Weather Modification to increase precipitation	No Infrastructure	Currently Operating											Yes	
IRRIGATION, CARSON	Irrigation conservation	239	$0	0	17,316	17,957	19,112	19,754	20,395	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, CARSON	Precipitation enhancement	815	$0	0	6,221	6,221	6,221	6,221	6,221	N	Weather Modification to increase precipitation	No Infrastructure	Currently Operating											Yes	
IRRIGATION, CHILDRESS	Irrigation conservation	239	$0	0	1,640	1,704	1,819	1,883	1,946	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, COLLINGSWORTH	Irrigation conservation	239	$0	0	2,879	3,021	3,276	3,418	3,560	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, DALLAM	Irrigation conservation	190	$0	0	59,275	108,476	121,561	122,958	122,958	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, DONLEY	Irrigation conservation	239	$0	0	2,910	3,031	3,249	3,370	3,490	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, DONLEY	Precipitation enhancement	815	$0	0	1,179	1,179	1,179	1,179	1,179	N	Weather Modification to increase precipitation	No Infrastructure	Currently Operating											Yes	
IRRIGATION, GRAY	Irrigation conservation	239	$0	0	5,279	5,475	5,825	6,019	6,214	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, GRAY	Precipitation enhancement	815	$0	0	1,886	1,886	1,886	1,886	1,886	N	Weather Modification to increase precipitation	No Infrastructure	Currently Operating											Yes	
IRRIGATION, HALL	Irrigation conservation	239	$0	0	3,220	3,354	3,595	3,728	3,862	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, HANSFORD	Irrigation conservation	239	$0	0	24,436	45,264	51,215	51,951	51,951	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, HARTLEY	Irrigation conservation	190	$0	0	53,755	98,786	110,553	111,772	111,772	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, HEMPHILL	Irrigation conservation	239	$0	0	228	237	253	260	268	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, HUTCHINSON	Irrigation conservation	190	$0	0	7,514	14,044	15,905	16,128	16,128	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, HUTCHINSON	Precipitation enhancement	815	$0	0	2,965	2,965	2,965	2,965	2,965	N	Weather Modification to increase precipitation	No Infrastructure	Currently Operating											Yes	
IRRIGATION, LIPSCOMB	Irrigation conservation	239	$0	0	2,279	2,360	2,506	2,587	2,668	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, MOORE	Irrigation conservation	190	$0	0	31,602	58,995	66,995	67,846	67,846	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, OCHILTREE	Irrigation conservation	239	$0	0	17,257	17,899	19,053	19,694	20,335	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, OLDHAM	Irrigation conservation	239	$0	0	814	844	900	930	961	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, POTTER	Irrigation conservation	239	$0	0	936	974	1,041	1,077	1,114	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, POTTER	Precipitation enhancement	815	$0	0	361	361	361	361	361	N	Weather Modification to increase precipitation	No Infrastructure	Currently Operating											Yes	
IRRIGATION, RANDALL	Irrigation conservation	190	$0	0	18,028	18,673	19,835	20,481	21,126	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, ROBERTS	Irrigation conservation	239	$0	0	2,772	2,893	3,114	3,236	3,357	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, ROBERTS	Precipitation enhancement	815	$0	0	1,194	1,194	1,194	1,194	1,194	N	Weather Modification to increase precipitation	No Infrastructure	Currently Operating											Yes	
IRRIGATION, SHERMAN	Irrigation conservation	190	$0	0	41,128	77,102	86,803	87,896	87,896	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, WHEELER	Irrigation conservation	239	$0	0	1,676	1,740	1,854	1,917	1,980	N	Irrigation Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
IRRIGATION, WHEELER	Precipitation enhancement	815	$0	0	615	615	615	615	615	N	Weather Modification to increase precipitation	No Infrastructure	Currently Operating											Yes	
LEFORS	Drill additional groundwater well	194	$1,132,500	0	0	0	100	100	100	N	Develop wellfield	Wells	Not Implemented	Other										No	No longer a WUG

2011 Strategy Implementation Survey

Sponsor	Recommended Water Management Strategy	DBProjectId	CapitalCost	SS2010	SS2020	SS2030	SS2040	SS2050	SS2060	Y denotes strategies with supply volumes included in other strategies	Project Description	Infrastructure Type*	At what level of Implementation is the project?*	If not implemented, why?*	Initial Volume of Water Provided (acft/yr)	Funds Expended to Date ($)	Project Cost ($) (should include development and construction costs)	Year the Project is Online?*	Is this a phased project?*	(Phased) Ultimate Volume (acft/yr)	(Phased) Ultimate Project Cost ($)	Year project reaches maximum capacity?*	What is the project funding source(s)?*	Included in the 2016 Plan?*	Comments
LEFORS	Municipal conservation	188	$0	0	3	4	4	4	4	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	No longer a WUG
MANUFACTURING, HUTCHINSON	Voluntary transfers from other users	192	$0	0	0	664	664	1,252	1,500	Y	Purchase from Borger	Other	Not Implemented	Other										Yes	
MANUFACTURING, MOORE	Voluntary transfers from other users	192	$0	200	800	1,100	1,400	1,800	2,100	Y	Purchase from Cactus	Other	Not Implemented	Other										Yes	
MANUFACTURING, POTTER	Voluntary transfers from other users	192	$0	0	0	644	1,415	2,159	2,863	Y	Purchase from Amarillo	Other	Not Implemented	Other										Yes	
MEMPHIS	Drill additional groundwater well	194	$1,042,100	0	100	100	100	100	100	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
MEMPHIS	Municipal conservation	188	$0	0	13	22	22	22	22	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
MEMPHIS	Voluntary transfers from other users	192	$0	0	0	100	100	100	100	N	Purchase from prvoider	Other	Not Implemented	Other										No	Memphis has an emergency contract with GMIWA. This is no longer a long-term supply.
PALO DURO RIVER AUTHORITY	Palo Duro Reservoir	195	$114,730,000	0	0	3,875	3,833	3,792	3,750	N	Transmission system to Palo Duro Reservoir	Pipeline	Not Implemented	Other										Yes	Included as an alternative strategy
PAMPA	Drill additional groundwater well	194	$1,731,100	968	2,581	0	0	0	0	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
PAMPA	Municipal conservation	188	$0	0	15	65	65	65	65	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
PAMPA	Voluntary transfers from other users	192	$0	0	0	0	0	1,000	1,000	N	Purchase from prvoider	No Infrastructure	Not Implemented	Other										No	
PANHANDLE	Drill additional groundwater well	194	$3,309,300	0	0	600	600	600	600	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
PANHANDLE	Municipal conservation	188	$0	0	17	29	28	25	23	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
PERRYTON	Drill additional groundwater well	194	$7,087,000	0	0	0	0	600	1,200	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
PERRYTON	Municipal conservation	188	$0	0	64	113	118	120	123	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
SPEARMAN	Drill additional groundwater well	194	$3,862,000	0	0	900	900	900	900	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
SPEARMAN	Municipal conservation	188	$0	0	22	39	41	42	42	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
STEAM ELECTRIC POWER, MOORE	Drill additional groundwater well	194	$1,852,600	200	200	200	200	200	200	N	Develop wellfield	Wells	Not Implemented	Other										No	No longer a need in the 2016 Plan
SUNRAY	Drill additional groundwater well	194	$3,121,300	0	0	800	800	800	800	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
SUNRAY	Municipal conservation	188	$0	0	18	34	36	38	39	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
TEXLINE	Drill additional groundwater well	194	$2,304,000	0	250	250	250	250	250	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
TEXLINE	Municipal conservation	188	$0	0	7	12	12	12	11	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	
WHEELER	Drill additional groundwater well	194	$2,233,300	0	0	0	0	200	200	N	Develop wellfield	Wells	Not Implemented	Other										Yes	
WHEELER	Municipal conservation	188	$0	0	9	15	15	15	15	N	Municipal Conservation	No Infrastructure	Sponsor Has Taken Official Action to Initiate Project											Yes	

Appendix K

Data Tables

Appendix K, Data Tables

Preface

As required by regional water planning rules and guidelines, the data used in developing the regional water plans must be reported by water user, source, county and basin. These data are incorporated into the state water planning database, hence forward called "DB17".

Data tables are developed by water user group (WUG), wholesale water provider (WWP), and water source. Unfortunately, not all of the data easily fits into the structure of DB17. Specifically, groundwater sources are not constrained by political boundaries (county and regional lines), nor by river basin divides. However, this water source is represented as such.

Water supplies must be identified by source. This includes source type (surface water, groundwater, reuse, aquifer storage and recovery or precipitation enhancement), location (reservoir, county, basin), and river basin. Water users that utilize multiple sources of water must account for the quantity and end user of each source. This structure is very difficult to represent systems that blend multiple sources of water prior to distribution. It also poses challenges to accurately represent conjunctive use strategies that use different volumes of water from each source, pending annual availability. Generally, for conjunctive use operations, the decadal averages are represented in DB17.

The following data tables represent, to the best of the consultant's ability, the essence of the regional water plan. For some water user groups, the entity sells water to other users. These sales are included in the projected water needs for the water users in the regional plan. This relationship between seller and customer are represented in DB17, but may not be reflected in the following data reports. As a result, there may be differences in projected water needs between the regional water plan chapter tables and the data reports.

Also, the report tables were developed for each user group as a whole, regardless of county or basin splits. The splitting of these data by counties and basin can result in rounding differences between the report tables and following data tables. Differences of less than 10 on a county basis are considered consistent with the regional water plan report.

While the DB17 data adequately represents the regional water plan within the constraints of the data structure, it is highly recommended that the user of this data refer to the written plan for clarification and description of the water needs and water management strategies.

Source Availability

REGION A

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
BLAINE AQUIFER	CHILDRESS	RED	FRESH	15,206	15,206	15,206	15,206	15,206	15,206
BLAINE AQUIFER	COLLINGSWORTH	RED	FRESH	185,376	185,376	185,376	185,376	185,376	185,376
BLAINE AQUIFER	HALL	RED	FRESH	11,509	11,509	11,509	11,509	11,509	11,509
BLAINE AQUIFER	WHEELER	RED	FRESH	98,997	98,997	98,997	98,997	97,695	96,410
DOCKUM AQUIFER	ARMSTRONG	RED	FRESH	582	582	582	582	582	582
DOCKUM AQUIFER	CARSON	CANADIAN	FRESH	20	20	20	20	20	20
DOCKUM AQUIFER	CARSON	RED	FRESH	263	263	263	263	263	263
DOCKUM AQUIFER	DALLAM	CANADIAN	FRESH	4,034	4,034	4,034	4,034	4,034	4,034
DOCKUM AQUIFER	HARTLEY	CANADIAN	FRESH	3,567	3,567	3,567	3,567	3,567	3,567
DOCKUM AQUIFER	MOORE	CANADIAN	FRESH	5,395	5,395	5,395	5,395	5,395	5,395
DOCKUM AQUIFER	OLDHAM	CANADIAN	FRESH	2,868	2,868	2,868	2,868	2,868	2,868
DOCKUM AQUIFER	OLDHAM	RED	FRESH	104	104	104	104	104	104
DOCKUM AQUIFER	POTTER	CANADIAN	FRESH	1,525	1,525	1,525	1,525	1,525	1,525
DOCKUM AQUIFER	POTTER	RED	FRESH	155	155	155	155	155	155
DOCKUM AQUIFER	RANDALL	RED	FRESH	2,119	2,119	2,119	2,119	2,119	2,119
DOCKUM AQUIFER	SHERMAN	CANADIAN	FRESH	591	591	591	591	591	591
OGALLALA AQUIFER	ARMSTRONG	RED	FRESH	45,367	41,079	37,416	34,161	31,328	28,730
OGALLALA AQUIFER	CARSON	CANADIAN	FRESH	81,718	73,958	66,324	59,324	53,120	47,565
OGALLALA AQUIFER	CARSON	RED	FRESH	89,424	80,108	71,529	63,665	56,289	49,768
OGALLALA AQUIFER	DONLEY	RED	FRESH	74,540	70,208	64,373	58,707	53,537	48,822
OGALLALA AQUIFER	GRAY	CANADIAN	FRESH	39,813	36,848	33,749	30,659	27,766	25,146
OGALLALA AQUIFER	GRAY	RED	FRESH	120,860	109,180	98,784	89,135	80,128	72,031
OGALLALA AQUIFER	HANSFORD	CANADIAN	FRESH	262,271	240,502	218,405	197,454	177,536	159,627
OGALLALA AQUIFER	HEMPHILL	CANADIAN	FRESH	22,931	22,969	23,262	23,412	23,642	23,874
OGALLALA AQUIFER	HEMPHILL	RED	FRESH	18,828	19,429	19,515	19,577	19,517	19,457
OGALLALA AQUIFER	HUTCHINSON	CANADIAN	FRESH	136,433	124,573	112,149	100,575	90,438	81,323
OGALLALA AQUIFER	LIPSCOMB	CANADIAN	FRESH	283,794	273,836	256,406	237,765	219,100	201,900
OGALLALA AQUIFER	MOORE	CANADIAN	FRESH	199,354	173,987	147,617	123,573	103,113	86,041
OGALLALA AQUIFER	OCHILTREE	CANADIAN	FRESH	246,475	224,578	203,704	183,227	164,265	147,265
OGALLALA AQUIFER	OLDHAM	CANADIAN	FRESH	19,360	18,722	17,694	16,406	15,198	14,079
OGALLALA AQUIFER	OLDHAM	RED	FRESH	3,122	2,885	2,772	2,306	2,269	2,233
OGALLALA AQUIFER	POTTER	CANADIAN	FRESH	22,044	20,621	18,960	17,318	15,450	13,783
OGALLALA AQUIFER	POTTER	RED	FRESH	4,828	2,917	1,815	1,596	1,406	1,239
OGALLALA AQUIFER	RANDALL	RED	FRESH	85,614	82,398	75,698	68,881	58,384	49,487
OGALLALA AQUIFER	ROBERTS	CANADIAN	FRESH	372,950	350,415	321,680	290,903	261,482	235,037
OGALLALA AQUIFER	ROBERTS	RED	FRESH	17,951	18,202	17,565	16,609	15,557	14,572
OGALLALA AQUIFER	SHERMAN	CANADIAN	FRESH	300,908	263,747	229,122	197,480	169,172	144,922
OGALLALA AQUIFER	WHEELER	RED	FRESH	119,556	114,817	107,697	100,289	93,117	86,458
OGALLALA-RITA BLANCA AQUIFER	DALLAM	CANADIAN	FRESH	352,474	309,076	270,317	234,813	203,491	176,347
OGALLALA-RITA BLANCA AQUIFER	HARTLEY	CANADIAN	FRESH	389,548	337,001	291,094	250,966	216,098	186,074

Source Availability

REGION A

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	ARMSTRONG	RED	FRESH/BRACKISH	370	370	370	370	370	370
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	CHILDRESS	RED	FRESH/BRACKISH	233	233	233	233	233	233
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	COLLINGSWORTH	RED	FRESH/BRACKISH	309	309	309	309	309	309
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	DONLEY	RED	FRESH/BRACKISH	479	479	479	479	479	479
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	HALL	RED	FRESH/BRACKISH	1,086	1,086	1,086	1,086	1,086	1,086
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	WHEELER	RED	FRESH/BRACKISH	276	276	276	276	276	276
SEYMOUR AQUIFER	CHILDRESS	RED	FRESH	732	717	712	712	712	712
SEYMOUR AQUIFER	COLLINGSWORTH	RED	FRESH	16,010	14,250	13,348	11,329	10,241	9,257
SEYMOUR AQUIFER	HALL	RED	FRESH	12,020	11,462	10,866	11,085	11,172	11,260
GROUNDWATER TOTAL SOURCE AVAILABILITY				**3,673,989**	**3,373,549**	**3,067,637**	**2,776,991**	**2,507,290**	**2,269,486**

REGION A

REUSE	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
DIRECT REUSE	CARSON	RED	FRESH	57	58	58	58	58	58
DIRECT REUSE	CHILDRESS	RED	FRESH	162	166	169	172	177	181
DIRECT REUSE	COLLINGSWORTH	RED	FRESH	53	54	55	57	58	60
DIRECT REUSE	GRAY	CANADIAN	FRESH	220	220	220	220	220	220
DIRECT REUSE	HUTCHINSON	CANADIAN	FRESH	1,045	1,045	1,045	1,045	1,045	1,045
DIRECT REUSE	POTTER	CANADIAN	FRESH	26,087	27,504	29,108	30,711	34,815	38,369
DIRECT REUSE	POTTER	RED	FRESH	1,500	1,500	1,500	1,500	1,500	1,500
DIRECT REUSE	RANDALL	RED	FRESH	545	597	651	710	777	846
DIRECT REUSE	WHEELER	RED	FRESH	51	52	53	55	57	59
DIRECT REUSE | FROM MEMPHIS	HALL	RED	FRESH	100	100	100	100	100	100
REUSE TOTAL SOURCE AVAILABILITY				**29,820**	**31,296**	**32,959**	**34,628**	**38,807**	**42,438**

REGION A

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
CANADIAN LIVESTOCK LOCAL SUPPLY	CARSON	CANADIAN	FRESH	59	59	59	59	59	59
CANADIAN LIVESTOCK LOCAL SUPPLY	DALLAM	CANADIAN	FRESH	2,488	2,488	2,488	2,488	2,488	2,488
CANADIAN LIVESTOCK LOCAL SUPPLY	GRAY	CANADIAN	FRESH	199	199	199	199	199	199

Source Availability

REGION A

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
				2020	2030	2040	2050	2060	2070
CANADIAN LIVESTOCK LOCAL SUPPLY	HANSFORD	CANADIAN	FRESH	2,617	2,617	2,617	2,617	2,617	2,617
CANADIAN LIVESTOCK LOCAL SUPPLY	HARTLEY	CANADIAN	FRESH	3,193	3,193	3,193	3,193	3,193	3,193
CANADIAN LIVESTOCK LOCAL SUPPLY	HEMPHILL	CANADIAN	FRESH	248	248	248	248	248	248
CANADIAN LIVESTOCK LOCAL SUPPLY	HUTCHINSON	CANADIAN	FRESH	281	281	281	281	281	281
CANADIAN LIVESTOCK LOCAL SUPPLY	LIPSCOMB	CANADIAN	FRESH	110	110	110	110	110	110
CANADIAN LIVESTOCK LOCAL SUPPLY	MOORE	CANADIAN	FRESH	1,000	1,000	1,000	1,000	1,000	1,000
CANADIAN LIVESTOCK LOCAL SUPPLY	OCHILTREE	CANADIAN	FRESH	421	421	421	421	421	421
CANADIAN LIVESTOCK LOCAL SUPPLY	OLDHAM	CANADIAN	FRESH	626	626	626	626	626	626
CANADIAN LIVESTOCK LOCAL SUPPLY	POTTER	CANADIAN	FRESH	500	500	500	500	500	500
CANADIAN LIVESTOCK LOCAL SUPPLY	ROBERTS	CANADIAN	FRESH	124	124	124	124	124	124
CANADIAN LIVESTOCK LOCAL SUPPLY	SHERMAN	CANADIAN	FRESH	1,052	1,052	1,052	1,052	1,052	1,052
CANADIAN RUN-OF-RIVER	GRAY	CANADIAN	FRESH	1	1	1	1	1	1
CANADIAN RUN-OF-RIVER	HANSFORD	CANADIAN	FRESH	22	22	22	22	22	22
CANADIAN RUN-OF-RIVER	HUTCHINSON	CANADIAN	FRESH	98	98	98	98	98	98
CANADIAN RUN-OF-RIVER	LIPSCOMB	CANADIAN	FRESH	66	66	66	66	66	66
CANADIAN RUN-OF-RIVER	MOORE	CANADIAN	FRESH	7	7	7	7	7	7
CANADIAN RUN-OF-RIVER	ROBERTS	CANADIAN	FRESH	72	72	72	72	72	72
CANADIAN RUN-OF-RIVER	SHERMAN	CANADIAN	FRESH	32	32	32	32	32	32
GREENBELT LAKE/RESERVOIR	RESERVOIR	RED	FRESH	3,850	3,782	3,714	3,646	3,578	3,440
MEREDITH LAKE/RESERVOIR	RESERVOIR	CANADIAN	FRESH	0	0	0	0	0	0
PALO DURO LAKE/RESERVOIR	RESERVOIR	CANADIAN	FRESH	3,917	3,875	3,833	3,792	3,750	3,708
RED LIVESTOCK LOCAL SUPPLY	ARMSTRONG	RED	FRESH	122	122	122	122	122	122
RED LIVESTOCK LOCAL SUPPLY	CARSON	RED	FRESH	75	75	75	75	75	75
RED LIVESTOCK LOCAL SUPPLY	CHILDRESS	RED	FRESH	49	49	49	49	49	49
RED LIVESTOCK LOCAL SUPPLY	COLLINGSWORTH	RED	FRESH	29	29	29	29	29	29
RED LIVESTOCK LOCAL SUPPLY	DONLEY	RED	FRESH	283	283	283	283	283	283
RED LIVESTOCK LOCAL SUPPLY	GRAY	RED	FRESH	600	600	600	600	600	600
RED LIVESTOCK LOCAL SUPPLY	HALL	RED	FRESH	91	91	91	91	91	91
RED LIVESTOCK LOCAL SUPPLY	HEMPHILL	RED	FRESH	173	173	173	173	173	173

Source Availability

REGION A									
				SOURCE AVAILABILITY (ACRE-FEET PER YEAR)					
SURFACE WATER	COUNTY	BASIN	SALINITY	2020	2030	2040	2050	2060	2070
RED LIVESTOCK LOCAL SUPPLY	OLDHAM	RED	FRESH	209	209	209	209	209	209
RED LIVESTOCK LOCAL SUPPLY	POTTER	RED	FRESH	62	62	62	62	62	62
RED LIVESTOCK LOCAL SUPPLY	RANDALL	RED	FRESH	1,312	1,312	1,312	1,312	1,312	1,312
RED LIVESTOCK LOCAL SUPPLY	ROBERTS	RED	FRESH	15	15	15	15	15	15
RED LIVESTOCK LOCAL SUPPLY	WHEELER	RED	FRESH	845	845	845	845	845	845
RED RUN-OF-RIVER	CARSON	RED	FRESH	277	277	277	277	277	277
RED RUN-OF-RIVER	CHILDRESS	RED	FRESH	19	19	19	19	19	19
RED RUN-OF-RIVER	COLLINGSWORTH	RED	FRESH	851	851	851	851	851	851
RED RUN-OF-RIVER	DONLEY	RED	FRESH	166	166	166	166	166	166
RED RUN-OF-RIVER	GRAY	RED	FRESH	55	55	55	55	55	55
RED RUN-OF-RIVER	HALL	RED	FRESH	52	52	52	52	52	52
RED RUN-OF-RIVER	RANDALL	RED	FRESH	217	217	217	217	217	217
RED RUN-OF-RIVER	WHEELER	RED	FRESH	603	603	603	603	603	603
SURFACE WATER TOTAL SOURCE AVAILABILITY				**27,088**	**26,978**	**26,868**	**26,759**	**26,649**	**26,469**
REGION A TOTAL SOURCE AVAILABILITY				**3,730,897**	**3,431,823**	**3,127,464**	**2,838,378**	**2,572,746**	**2,338,393**

Source Water Balance (Availability- WUG Supply)

REGION A

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
				2020	2030	2040	2050	2060	2070
BLAINE AQUIFER	CHILDRESS	RED	FRESH	7,995	8,277	8,702	9,435	10,169	10,902
BLAINE AQUIFER	COLLINGSWORTH	RED	FRESH	176,121	176,455	176,965	177,860	178,763	179,666
BLAINE AQUIFER	HALL	RED	FRESH	11,509	11,509	11,509	11,509	11,509	11,509
BLAINE AQUIFER	WHEELER	RED	FRESH	98,948	98,948	98,948	98,948	97,646	96,361
DOCKUM AQUIFER	ARMSTRONG	RED	FRESH	566	566	566	566	566	566
DOCKUM AQUIFER	CARSON	CANADIAN	FRESH	20	20	20	20	20	20
DOCKUM AQUIFER	CARSON	RED	FRESH	263	263	263	263	263	263
DOCKUM AQUIFER	DALLAM	CANADIAN	FRESH	1,008	1,008	1,008	1,008	1,008	1,008
DOCKUM AQUIFER	HARTLEY	CANADIAN	FRESH	2,406	2,406	2,406	2,406	2,406	2,406
DOCKUM AQUIFER	MOORE	CANADIAN	FRESH	5,395	5,395	5,395	5,395	5,395	5,395
DOCKUM AQUIFER	OLDHAM	CANADIAN	FRESH	1,396	1,396	1,396	1,396	1,396	1,396
DOCKUM AQUIFER	OLDHAM	RED	FRESH	104	104	104	104	104	104
DOCKUM AQUIFER	POTTER	CANADIAN	FRESH	612	612	612	612	612	612
DOCKUM AQUIFER	POTTER	RED	FRESH	155	155	155	155	155	155
DOCKUM AQUIFER	RANDALL	RED	FRESH	932	943	953	963	972	981
DOCKUM AQUIFER	SHERMAN	CANADIAN	FRESH	591	591	591	591	591	591
OGALLALA AQUIFER	ARMSTRONG	RED	FRESH	40,133	36,103	32,770	29,966	27,580	25,428
OGALLALA AQUIFER	CARSON	CANADIAN	FRESH	60,201	54,119	48,497	43,645	39,336	35,684
OGALLALA AQUIFER	CARSON	RED	FRESH	40,967	34,929	30,037	26,724	23,864	21,866
OGALLALA AQUIFER	DONLEY	RED	FRESH	48,072	44,743	40,375	37,286	34,649	32,466
OGALLALA AQUIFER	GRAY	CANADIAN	FRESH	26,360	23,270	20,490	17,401	15,209	13,188
OGALLALA AQUIFER	GRAY	RED	FRESH	103,430	92,613	83,352	75,257	67,771	61,192
OGALLALA AQUIFER	HANSFORD	CANADIAN	FRESH	124,644	110,848	99,704	92,078	85,355	80,338
OGALLALA AQUIFER	HEMPHILL	CANADIAN	FRESH	19,262	19,503	20,021	20,427	20,917	21,270
OGALLALA AQUIFER	HEMPHILL	RED	FRESH	16,408	17,366	17,802	18,227	18,527	18,615
OGALLALA AQUIFER	HUTCHINSON	CANADIAN	FRESH	70,452	60,846	51,148	43,203	35,899	29,427
OGALLALA AQUIFER	LIPSCOMB	CANADIAN	FRESH	260,727	252,020	236,304	220,082	203,545	188,366
OGALLALA AQUIFER	MOORE	CANADIAN	FRESH	43,809	27,684	12,543	3,528	1,538	1,136
OGALLALA AQUIFER	OCHILTREE	CANADIAN	FRESH	181,999	164,385	148,448	133,902	120,651	109,195
OGALLALA AQUIFER	OLDHAM	CANADIAN	FRESH	15,828	15,242	14,330	13,316	12,350	11,468
OGALLALA AQUIFER	OLDHAM	RED	FRESH	2,045	1,837	1,776	1,395	1,442	1,489
OGALLALA AQUIFER	POTTER	CANADIAN	FRESH	8,325	9,293	8,146	7,134	5,928	4,893
OGALLALA AQUIFER	POTTER	RED	FRESH	3,674	1,703	547	298	58	33
OGALLALA AQUIFER	RANDALL	RED	FRESH	60,226	58,478	53,408	48,717	40,274	33,427
OGALLALA AQUIFER	ROBERTS	CANADIAN	FRESH	295,966	282,746	259,821	235,099	211,345	190,421
OGALLALA AQUIFER	ROBERTS	RED	FRESH	17,593	17,876	17,274	16,359	15,341	14,385
OGALLALA AQUIFER	SHERMAN	CANADIAN	FRESH	76,075	51,759	34,063	23,590	16,483	13,387
OGALLALA AQUIFER	WHEELER	RED	FRESH	105,654	102,171	96,603	91,024	85,124	79,384
OGALLALA-RITA BLANCA AQUIFER	DALLAM	CANADIAN	FRESH	60,789	51,909	44,334	37,406	31,792	30,342
OGALLALA-RITA BLANCA AQUIFER	HARTLEY	CANADIAN	FRESH	116,506	98,991	83,533	70,412	59,190	52,757

Source Water Balance (Availability- WUG Supply)

REGION A

GROUNDWATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	ARMSTRONG	RED	FRESH/BRACKISH	340	340	340	340	340	340
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	CHILDRESS	RED	FRESH/BRACKISH	0	0	0	0	0	0
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	COLLINGSWORTH	RED	FRESH/BRACKISH	0	0	0	0	0	0
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	DONLEY	RED	FRESH/BRACKISH	96	96	96	96	96	96
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	HALL	RED	FRESH/BRACKISH	0	0	0	0	65	168
OTHER AQUIFER | WHITEHORSE AND QUARTERMASTER FORMATIONS	WHEELER	RED	FRESH/BRACKISH	0	0	0	0	0	0
SEYMOUR AQUIFER	CHILDRESS	RED	FRESH	372	357	352	352	352	352
SEYMOUR AQUIFER	COLLINGSWORTH	RED	FRESH	6,808	5,382	4,990	3,874	3,689	3,608
SEYMOUR AQUIFER	HALL	RED	FRESH	2,667	2,437	2,373	3,623	4,675	5,691
GROUNDWATER TOTAL SOURCE WATER BALANCE				**2,117,449**	**1,947,694**	**1,773,070**	**1,625,992**	**1,494,960**	**1,392,347**

REGION A

REUSE	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
DIRECT REUSE	CARSON	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	CHILDRESS	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	COLLINGSWORTH	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	GRAY	CANADIAN	FRESH	0	0	0	0	0	0
DIRECT REUSE	HUTCHINSON	CANADIAN	FRESH	0	0	0	0	0	0
DIRECT REUSE	POTTER	CANADIAN	FRESH	0	0	0	0	0	0
DIRECT REUSE	POTTER	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	RANDALL	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE	WHEELER	RED	FRESH	0	0	0	0	0	0
DIRECT REUSE | FROM MEMPHIS	HALL	RED	FRESH	0	0	0	0	0	0
REUSE TOTAL SOURCE WATER BALANCE				**0**	**0**	**0**	**0**	**0**	**0**

REGION A

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
CANADIAN LIVESTOCK LOCAL SUPPLY	CARSON	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	DALLAM	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	GRAY	CANADIAN	FRESH	0	0	0	0	0	0

Source Water Balance (Availability- WUG Supply)

REGION A

SURFACE WATER	COUNTY	BASIN	SALINITY	SOURCE WATER BALANCE (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
CANADIAN LIVESTOCK LOCAL SUPPLY	HANSFORD	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	HARTLEY	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	HEMPHILL	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	HUTCHINSON	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	LIPSCOMB	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	MOORE	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	OCHILTREE	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	OLDHAM	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	POTTER	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	ROBERTS	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN LIVESTOCK LOCAL SUPPLY	SHERMAN	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	GRAY	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	HANSFORD	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	HUTCHINSON	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	LIPSCOMB	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	MOORE	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	ROBERTS	CANADIAN	FRESH	0	0	0	0	0	0
CANADIAN RUN-OF-RIVER	SHERMAN	CANADIAN	FRESH	0	0	0	0	0	0
GREENBELT LAKE/RESERVOIR	RESERVOIR	RED	FRESH	1,538	1,339	1,145	935	736	472
MEREDITH LAKE/RESERVOIR	RESERVOIR	CANADIAN	FRESH	0	0	0	0	0	0
PALO DURO LAKE/RESERVOIR	RESERVOIR	CANADIAN	FRESH	3,917	3,875	3,833	3,792	3,750	3,708
RED LIVESTOCK LOCAL SUPPLY	ARMSTRONG	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	CARSON	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	CHILDRESS	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	COLLINGSWORTH	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	DONLEY	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	GRAY	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	HALL	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	HEMPHILL	RED	FRESH	0	0	0	0	0	0

Source Water Balance (Availability- WUG Supply)

REGION A									
				SOURCE WATER BALANCE (ACRE-FEET PER YEAR)					
SURFACE WATER	**COUNTY**	**BASIN**	**SALINITY**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
RED LIVESTOCK LOCAL SUPPLY	OLDHAM	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	POTTER	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	RANDALL	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	ROBERTS	RED	FRESH	0	0	0	0	0	0
RED LIVESTOCK LOCAL SUPPLY	WHEELER	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	CARSON	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	CHILDRESS	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	COLLINGSWORTH	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	DONLEY	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	GRAY	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	HALL	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	RANDALL	RED	FRESH	0	0	0	0	0	0
RED RUN-OF-RIVER	WHEELER	RED	FRESH	0	0	0	0	0	0
SURFACE WATER TOTAL SOURCE WATER BALANCE				**5,455**	**5,214**	**4,978**	**4,727**	**4,486**	**4,180**
REGION A TOTAL SOURCE WATER BALANCE				**2,122,904**	**1,952,908**	**1,778,048**	**1,630,719**	**1,499,446**	**1,396,527**

Water User Group (WUG) Population

REGION A	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
ARMSTRONG COUNTY						
RED BASIN						
CLAUDE	1,203	1,203	1,203	1,203	1,203	1,203
COUNTY-OTHER	708	708	708	708	708	708
RED BASIN TOTAL POPULATION	**1,911**	**1,911**	**1,911**	**1,911**	**1,911**	**1,911**
ARMSTRONG COUNTY TOTAL POPULATION	**1,911**	**1,911**	**1,911**	**1,911**	**1,911**	**1,911**
CARSON COUNTY						
CANADIAN BASIN						
WHITE DEER	487	505	514	514	514	514
COUNTY-OTHER	1,231	1,258	1,279	1,279	1,279	1,279
CANADIAN BASIN TOTAL POPULATION	**1,718**	**1,763**	**1,793**	**1,793**	**1,793**	**1,793**
RED BASIN						
GROOM	574	574	574	574	574	574
PANHANDLE	2,491	2,583	2,631	2,631	2,631	2,631
WHITE DEER	638	662	674	674	674	674
COUNTY-OTHER	933	938	960	960	960	960
RED BASIN TOTAL POPULATION	**4,636**	**4,757**	**4,839**	**4,839**	**4,839**	**4,839**
CARSON COUNTY TOTAL POPULATION	**6,354**	**6,520**	**6,632**	**6,632**	**6,632**	**6,632**
CHILDRESS COUNTY						
RED BASIN						
CHILDRESS	6,303	6,543	6,743	6,938	7,132	7,321
COUNTY-OTHER	966	1,003	1,033	1,063	1,093	1,122
RED BASIN TOTAL POPULATION	**7,269**	**7,546**	**7,776**	**8,001**	**8,225**	**8,443**
CHILDRESS COUNTY TOTAL POPULATION	**7,269**	**7,546**	**7,776**	**8,001**	**8,225**	**8,443**
COLLINGSWORTH COUNTY						
RED BASIN						
WELLINGTON	2,318	2,441	2,522	2,616	2,689	2,753
COUNTY-OTHER	918	967	1,000	1,037	1,066	1,091
RED BASIN TOTAL POPULATION	**3,236**	**3,408**	**3,522**	**3,653**	**3,755**	**3,844**
COLLINGSWORTH COUNTY TOTAL POPULATION	**3,236**	**3,408**	**3,522**	**3,653**	**3,755**	**3,844**
DALLAM COUNTY						
CANADIAN BASIN						
DALHART	5,986	6,741	7,534	8,317	9,069	9,794
TEXLINE	586	660	738	814	888	959
COUNTY-OTHER	1,172	1,319	1,475	1,628	1,776	1,918
CANADIAN BASIN TOTAL POPULATION	**7,744**	**8,720**	**9,747**	**10,759**	**11,733**	**12,671**
DALLAM COUNTY TOTAL POPULATION	**7,744**	**8,720**	**9,747**	**10,759**	**11,733**	**12,671**
DONLEY COUNTY						
RED BASIN						
CLARENDON	2,088	2,088	2,088	2,088	2,088	2,088
COUNTY-OTHER	1,700	1,700	1,700	1,700	1,700	1,700

Water User Group (WUG) Population

REGION A	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
DONLEY COUNTY						
RED BASIN TOTAL POPULATION	**3,788**	**3,788**	**3,788**	**3,788**	**3,788**	**3,788**
DONLEY COUNTY TOTAL POPULATION	**3,788**	**3,788**	**3,788**	**3,788**	**3,788**	**3,788**
GRAY COUNTY						
CANADIAN BASIN						
PAMPA	19,515	21,596	24,089	27,298	29,854	32,523
COUNTY-OTHER	2,650	2,933	3,271	3,706	4,054	4,416
CANADIAN BASIN TOTAL POPULATION	**22,165**	**24,529**	**27,360**	**31,004**	**33,908**	**36,939**
RED BASIN						
MCLEAN	844	934	1,042	1,181	1,291	1,407
COUNTY-OTHER	1,430	1,583	1,766	2,001	2,189	2,384
RED BASIN TOTAL POPULATION	**2,274**	**2,517**	**2,808**	**3,182**	**3,480**	**3,791**
GRAY COUNTY TOTAL POPULATION	**24,439**	**27,046**	**30,168**	**34,186**	**37,388**	**40,730**
HALL COUNTY						
RED BASIN						
MEMPHIS	2,318	2,382	2,382	2,382	2,382	2,382
COUNTY-OTHER	1,075	1,105	1,105	1,105	1,105	1,105
RED BASIN TOTAL POPULATION	**3,393**	**3,487**	**3,487**	**3,487**	**3,487**	**3,487**
HALL COUNTY TOTAL POPULATION	**3,393**	**3,487**	**3,487**	**3,487**	**3,487**	**3,487**
HANSFORD COUNTY						
CANADIAN BASIN						
GRUVER	1,306	1,447	1,570	1,673	1,777	1,873
SPEARMAN	3,505	3,648	3,759	3,873	3,991	4,113
COUNTY-OTHER	1,148	1,273	1,381	1,471	1,562	1,648
CANADIAN BASIN TOTAL POPULATION	**5,959**	**6,368**	**6,710**	**7,017**	**7,330**	**7,634**
HANSFORD COUNTY TOTAL POPULATION	**5,959**	**6,368**	**6,710**	**7,017**	**7,330**	**7,634**
HARTLEY COUNTY						
CANADIAN BASIN						
DALHART	2,816	2,923	2,980	3,021	3,058	3,087
COUNTY-OTHER	3,465	3,708	3,837	3,929	4,011	4,077
CANADIAN BASIN TOTAL POPULATION	**6,281**	**6,631**	**6,817**	**6,950**	**7,069**	**7,164**
HARTLEY COUNTY TOTAL POPULATION	**6,281**	**6,631**	**6,817**	**6,950**	**7,069**	**7,164**
HEMPHILL COUNTY						
CANADIAN BASIN						
CANADIAN	3,016	3,381	3,691	4,010	4,295	4,556
COUNTY-OTHER	873	878	881	885	888	892
CANADIAN BASIN TOTAL POPULATION	**3,889**	**4,259**	**4,572**	**4,895**	**5,183**	**5,448**
RED BASIN						
COUNTY-OTHER	320	350	376	402	426	447
RED BASIN TOTAL POPULATION	**320**	**350**	**376**	**402**	**426**	**447**
HEMPHILL COUNTY TOTAL POPULATION	**4,209**	**4,609**	**4,948**	**5,297**	**5,609**	**5,895**

Water User Group (WUG) Population

REGION A	WUG POPULATION					
	2020	2030	2040	2050	2060	2070
HUTCHINSON COUNTY						
CANADIAN BASIN						
BORGER	13,734	14,226	14,352	14,352	14,352	14,352
FRITCH	2,186	2,265	2,285	2,285	2,285	2,285
STINNETT	1,950	2,020	2,038	2,038	2,038	2,038
TCW SUPPLY INC	2,167	2,244	2,264	2,264	2,264	2,264
COUNTY-OTHER	2,920	3,024	3,051	3,051	3,051	3,051
CANADIAN BASIN TOTAL POPULATION	**22,957**	**23,779**	**23,990**	**23,990**	**23,990**	**23,990**
HUTCHINSON COUNTY TOTAL POPULATION	**22,957**	**23,779**	**23,990**	**23,990**	**23,990**	**23,990**
LIPSCOMB COUNTY						
CANADIAN BASIN						
BOOKER	1,740	1,948	2,071	2,232	2,344	2,436
COUNTY-OTHER	1,859	1,910	1,940	1,979	2,006	2,029
CANADIAN BASIN TOTAL POPULATION	**3,599**	**3,858**	**4,011**	**4,211**	**4,350**	**4,465**
LIPSCOMB COUNTY TOTAL POPULATION	**3,599**	**3,858**	**4,011**	**4,211**	**4,350**	**4,465**
MOORE COUNTY						
CANADIAN BASIN						
CACTUS	4,232	4,824	5,455	6,095	6,763	7,444
DUMAS	16,897	19,260	21,777	24,331	26,995	29,725
FRITCH	10	11	12	14	15	17
SUNRAY	2,216	2,525	2,855	3,190	3,540	3,897
COUNTY-OTHER	2,413	2,752	3,111	3,476	3,857	4,247
CANADIAN BASIN TOTAL POPULATION	**25,768**	**29,372**	**33,210**	**37,106**	**41,170**	**45,330**
MOORE COUNTY TOTAL POPULATION	**25,768**	**29,372**	**33,210**	**37,106**	**41,170**	**45,330**
OCHILTREE COUNTY						
CANADIAN BASIN						
BOOKER	22	33	45	58	74	92
PERRYTON	9,728	10,454	11,234	12,073	12,974	13,943
COUNTY-OTHER	1,555	1,671	1,796	1,930	2,074	2,229
CANADIAN BASIN TOTAL POPULATION	**11,305**	**12,158**	**13,075**	**14,061**	**15,122**	**16,264**
OCHILTREE COUNTY TOTAL POPULATION	**11,305**	**12,158**	**13,075**	**14,061**	**15,122**	**16,264**
OLDHAM COUNTY						
CANADIAN BASIN						
VEGA	961	1,024	1,024	1,024	1,024	1,024
COUNTY-OTHER	1,022	1,089	1,089	1,089	1,089	1,089
CANADIAN BASIN TOTAL POPULATION	**1,983**	**2,113**	**2,113**	**2,113**	**2,113**	**2,113**
RED BASIN						
COUNTY-OTHER	247	263	263	263	263	263
RED BASIN TOTAL POPULATION	**247**	**263**	**263**	**263**	**263**	**263**
OLDHAM COUNTY TOTAL POPULATION	**2,230**	**2,376**	**2,376**	**2,376**	**2,376**	**2,376**

Water User Group (WUG) Population

REGION A	WUG POPULATION					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
POTTER COUNTY						
CANADIAN BASIN						
AMARILLO	70,415	78,259	86,558	94,822	103,832	113,322
COUNTY-OTHER	11,034	12,262	13,563	14,857	16,270	17,757
CANADIAN BASIN TOTAL POPULATION	**81,449**	**90,521**	**100,121**	**109,679**	**120,102**	**131,079**
RED BASIN						
AMARILLO	46,360	51,523	56,988	62,428	68,361	74,609
COUNTY-OTHER	6,222	6,916	7,648	8,379	9,175	10,013
RED BASIN TOTAL POPULATION	**52,582**	**58,439**	**64,636**	**70,807**	**77,536**	**84,622**
POTTER COUNTY TOTAL POPULATION	**134,031**	**148,960**	**164,757**	**180,486**	**197,638**	**215,701**
RANDALL COUNTY						
RED BASIN						
AMARILLO	94,816	106,024	117,243	128,735	140,962	153,663
CANYON	14,803	16,553	18,305	20,099	22,008	23,991
HAPPY	68	76	84	93	101	111
LAKE TANGLEWOOD	820	820	820	820	820	820
COUNTY-OTHER	23,762	26,571	29,383	32,263	35,328	38,510
RED BASIN TOTAL POPULATION	**134,269**	**150,044**	**165,835**	**182,010**	**199,219**	**217,095**
RANDALL COUNTY TOTAL POPULATION	**134,269**	**150,044**	**165,835**	**182,010**	**199,219**	**217,095**
ROBERTS COUNTY						
CANADIAN BASIN						
MIAMI	613	623	624	624	624	624
COUNTY-OTHER	387	420	419	419	419	419
CANADIAN BASIN TOTAL POPULATION	**1,000**	**1,043**	**1,043**	**1,043**	**1,043**	**1,043**
RED BASIN						
COUNTY-OTHER	3	4	4	4	4	4
RED BASIN TOTAL POPULATION	**3**	**4**	**4**	**4**	**4**	**4**
ROBERTS COUNTY TOTAL POPULATION	**1,003**	**1,047**	**1,047**	**1,047**	**1,047**	**1,047**
SHERMAN COUNTY						
CANADIAN BASIN						
STRATFORD	2,190	2,374	2,474	2,562	2,626	2,673
COUNTY-OTHER	1,104	1,197	1,246	1,291	1,323	1,347
CANADIAN BASIN TOTAL POPULATION	**3,294**	**3,571**	**3,720**	**3,853**	**3,949**	**4,020**
SHERMAN COUNTY TOTAL POPULATION	**3,294**	**3,571**	**3,720**	**3,853**	**3,949**	**4,020**
WHEELER COUNTY						
RED BASIN						
SHAMROCK	1,973	2,051	2,126	2,203	2,288	2,378
WHEELER	1,645	1,710	1,772	1,836	1,907	1,982
COUNTY-OTHER	1,969	2,048	2,121	2,200	2,283	2,373
RED BASIN TOTAL POPULATION	**5,587**	**5,809**	**6,019**	**6,239**	**6,478**	**6,733**
WHEELER COUNTY TOTAL POPULATION	**5,587**	**5,809**	**6,019**	**6,239**	**6,478**	**6,733**

Water User Group (WUG) Population

REGION A TOTAL POPULATION	**418,626**	**461,008**	**503,546**	**547,060**	**592,266**	**639,220**

Water User Group (WUG) Demand

REGION A	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARMSTRONG COUNTY						
RED BASIN						
CLAUDE	358	353	348	346	345	345
COUNTY-OTHER	89	85	84	83	83	83
LIVESTOCK	645	649	652	656	659	663
IRRIGATION	4,194	3,990	3,708	3,296	2,884	2,472
RED BASIN TOTAL DEMAND	**5,286**	**5,077**	**4,792**	**4,381**	**3,971**	**3,563**
ARMSTRONG COUNTY TOTAL DEMAND	**5,286**	**5,077**	**4,792**	**4,381**	**3,971**	**3,563**
CARSON COUNTY						
CANADIAN BASIN						
WHITE DEER	106	107	107	107	107	107
COUNTY-OTHER	161	161	160	158	157	157
MANUFACTURING	25	28	30	32	35	37
MINING	14	14	14	14	14	14
LIVESTOCK	519	522	525	528	532	535
IRRIGATION	14,483	13,738	12,682	11,273	9,864	8,454
CANADIAN BASIN TOTAL DEMAND	**15,308**	**14,570**	**13,518**	**12,112**	**10,709**	**9,304**
RED BASIN						
GROOM	179	176	174	173	173	173
PANHANDLE	572	581	582	577	576	576
WHITE DEER	138	141	141	140	140	140
COUNTY-OTHER	123	120	120	119	119	119
MANUFACTURING	394	432	469	500	541	587
LIVESTOCK	173	174	175	176	177	178
IRRIGATION	41,219	39,100	36,094	32,083	28,073	24,063
RED BASIN TOTAL DEMAND	**42,798**	**40,724**	**37,755**	**33,768**	**29,799**	**25,836**
CARSON COUNTY TOTAL DEMAND	**58,106**	**55,294**	**51,273**	**45,880**	**40,508**	**35,140**
CHILDRESS COUNTY						
RED BASIN						
CHILDRESS	1,624	1,658	1,686	1,722	1,768	1,814
COUNTY-OTHER	198	204	210	216	222	227
LIVESTOCK	490	493	495	497	500	503
IRRIGATION	7,308	7,026	6,601	5,868	5,134	4,401
RED BASIN TOTAL DEMAND	**9,620**	**9,381**	**8,992**	**8,303**	**7,624**	**6,945**
CHILDRESS COUNTY TOTAL DEMAND	**9,620**	**9,381**	**8,992**	**8,303**	**7,624**	**6,945**
COLLINGSWORTH COUNTY						
RED BASIN						
WELLINGTON	525	540	549	567	582	595
COUNTY-OTHER	191	197	200	207	212	217
LIVESTOCK	600	603	605	608	611	614
IRRIGATION	17,943	17,276	16,255	14,449	12,643	10,837
RED BASIN TOTAL DEMAND	**19,259**	**18,616**	**17,609**	**15,831**	**14,048**	**12,263**
COLLINGSWORTH COUNTY TOTAL DEMAND	**19,259**	**18,616**	**17,609**	**15,831**	**14,048**	**12,263**
DALLAM COUNTY						
CANADIAN BASIN						
DALHART	1,815	2,014	2,228	2,447	2,666	2,878
TEXLINE	227	253	280	308	335	362
COUNTY-OTHER	141	151	166	183	199	214

Water User Group (WUG) Demand

REGION A	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
DALLAM COUNTY						
CANADIAN BASIN						
MANUFACTURING	9	9	10	10	11	11
LIVESTOCK	4,437	4,669	4,920	5,191	5,485	5,803
IRRIGATION	369,864	347,524	318,795	283,373	247,952	212,530
CANADIAN BASIN TOTAL DEMAND	**376,493**	**354,620**	**326,399**	**291,512**	**256,648**	**221,798**
DALLAM COUNTY TOTAL DEMAND	**376,493**	**354,620**	**326,399**	**291,512**	**256,648**	**221,798**
DONLEY COUNTY						
RED BASIN						
CLARENDON	378	369	361	356	356	356
COUNTY-OTHER	245	237	230	228	227	227
LIVESTOCK	1,330	1,332	1,333	1,335	1,337	1,339
IRRIGATION	24,080	23,203	21,847	19,419	16,992	14,564
RED BASIN TOTAL DEMAND	**26,033**	**25,141**	**23,771**	**21,338**	**18,912**	**16,486**
DONLEY COUNTY TOTAL DEMAND	**26,033**	**25,141**	**23,771**	**21,338**	**18,912**	**16,486**
GRAY COUNTY						
CANADIAN BASIN						
PAMPA	3,711	3,991	4,360	4,926	5,377	5,855
COUNTY-OTHER	450	488	537	604	659	717
MANUFACTURING	4,133	4,197	4,240	4,257	4,086	3,923
MINING	7	7	7	6	5	5
STEAM ELECTRIC POWER	1,409	2,112	2,299	2,952	3,087	3,320
LIVESTOCK	135	138	141	144	147	151
IRRIGATION	5,536	5,227	4,820	4,285	3,749	3,213
CANADIAN BASIN TOTAL DEMAND	**15,381**	**16,160**	**16,404**	**17,174**	**17,110**	**17,184**
RED BASIN						
MCLEAN	205	222	243	274	299	326
COUNTY-OTHER	243	264	290	326	356	388
MANUFACTURING	217	221	223	224	215	206
MINING	68	67	60	54	48	42
LIVESTOCK	1,217	1,240	1,266	1,294	1,326	1,360
IRRIGATION	15,755	14,877	13,719	12,194	10,670	9,146
RED BASIN TOTAL DEMAND	**17,705**	**16,891**	**15,801**	**14,366**	**12,914**	**11,468**
GRAY COUNTY TOTAL DEMAND	**33,086**	**33,051**	**32,205**	**31,540**	**30,024**	**28,652**
HALL COUNTY						
RED BASIN						
MEMPHIS	383	382	372	370	369	369
COUNTY-OTHER	319	322	320	319	319	319
LIVESTOCK	336	337	339	340	341	343
IRRIGATION	10,134	9,806	9,274	8,243	7,213	6,182
RED BASIN TOTAL DEMAND	**11,172**	**10,847**	**10,305**	**9,272**	**8,242**	**7,213**
HALL COUNTY TOTAL DEMAND	**11,172**	**10,847**	**10,305**	**9,272**	**8,242**	**7,213**
HANSFORD COUNTY						
CANADIAN BASIN						
GRUVER	310	336	360	380	404	425
SPEARMAN	672	683	691	704	724	746
COUNTY-OTHER	138	145	157	167	176	186
MANUFACTURING	58	61	63	65	70	74

Water User Group (WUG) Demand

REGION A	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
HANSFORD COUNTY						
CANADIAN BASIN						
MINING	577	904	602	309	16	1
LIVESTOCK	3,432	3,574	3,724	3,881	4,046	4,219
IRRIGATION	134,902	126,481	115,759	102,897	90,035	77,173
CANADIAN BASIN TOTAL DEMAND	**140,089**	**132,184**	**121,356**	**108,403**	**95,471**	**82,824**
HANSFORD COUNTY TOTAL DEMAND	**140,089**	**132,184**	**121,356**	**108,403**	**95,471**	**82,824**
HARTLEY COUNTY						
CANADIAN BASIN						
DALHART	854	874	882	889	899	907
COUNTY-OTHER	655	687	700	711	725	737
MANUFACTURING	5	5	5	5	5	5
MINING	7	7	6	5	4	3
LIVESTOCK	6,498	6,977	7,498	8,066	8,684	9,359
IRRIGATION	345,365	325,882	300,290	266,924	233,559	200,193
CANADIAN BASIN TOTAL DEMAND	**353,384**	**334,432**	**309,381**	**276,600**	**243,876**	**211,204**
HARTLEY COUNTY TOTAL DEMAND	**353,384**	**334,432**	**309,381**	**276,600**	**243,876**	**211,204**
HEMPHILL COUNTY						
CANADIAN BASIN						
CANADIAN	786	866	934	1,009	1,079	1,145
COUNTY-OTHER	115	112	109	109	109	109
MANUFACTURING	6	6	6	6	6	6
MINING	926	705	498	293	89	27
LIVESTOCK	757	760	763	766	769	773
IRRIGATION	1,316	1,251	1,162	1,033	904	775
CANADIAN BASIN TOTAL DEMAND	**3,906**	**3,700**	**3,472**	**3,216**	**2,956**	**2,835**
RED BASIN						
COUNTY-OTHER	43	45	46	49	52	55
MINING	1,388	1,058	746	439	134	41
LIVESTOCK	518	519	521	523	526	529
IRRIGATION	591	563	523	465	407	349
RED BASIN TOTAL DEMAND	**2,540**	**2,185**	**1,836**	**1,476**	**1,119**	**974**
HEMPHILL COUNTY TOTAL DEMAND	**6,446**	**5,885**	**5,308**	**4,692**	**4,075**	**3,809**
HUTCHINSON COUNTY						
CANADIAN BASIN						
BORGER	3,215	3,254	3,234	3,229	3,225	3,224
FRITCH	437	441	436	434	433	433
STINNETT	446	452	448	447	446	446
TCW SUPPLY INC	738	755	754	750	749	749
COUNTY-OTHER	312	319	321	320	320	319
MANUFACTURING	25,347	26,827	28,249	29,483	31,540	33,741
MINING	184	231	170	113	56	34
LIVESTOCK	847	873	903	935	971	1,010
IRRIGATION	40,008	37,671	34,635	30,786	26,938	23,090
CANADIAN BASIN TOTAL DEMAND	**71,534**	**70,823**	**69,150**	**66,497**	**64,678**	**63,046**
HUTCHINSON COUNTY TOTAL DEMAND	**71,534**	**70,823**	**69,150**	**66,497**	**64,678**	**63,046**

Water User Group (WUG) Demand

REGION A	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
LIPSCOMB COUNTY						
CANADIAN BASIN						
BOOKER	496	547	576	618	648	674
COUNTY-OTHER	445	448	447	453	459	464
MANUFACTURING	147	155	161	167	180	193
MINING	1,098	758	446	142	21	3
LIVESTOCK	947	969	993	1,020	1,050	1,083
IRRIGATION	20,009	19,014	17,650	15,689	13,728	11,767
CANADIAN BASIN TOTAL DEMAND	**23,142**	**21,891**	**20,273**	**18,089**	**16,086**	**14,184**
LIPSCOMB COUNTY TOTAL DEMAND	**23,142**	**21,891**	**20,273**	**18,089**	**16,086**	**14,184**
MOORE COUNTY						
CANADIAN BASIN						
CACTUS	985	1,108	1,242	1,382	1,532	1,686
DUMAS	3,538	3,941	4,388	4,866	5,391	5,933
FRITCH	2	3	3	3	3	4
SUNRAY	504	562	626	695	770	847
COUNTY-OTHER	327	360	397	439	486	534
MANUFACTURING	9,052	9,549	10,038	10,469	11,179	11,937
MINING	16	16	16	15	15	15
STEAM ELECTRIC POWER	200	0	0	0	0	0
LIVESTOCK	3,676	3,906	4,155	4,424	4,716	5,032
IRRIGATION	143,028	134,395	123,290	109,591	95,892	82,193
CANADIAN BASIN TOTAL DEMAND	**161,328**	**153,840**	**144,155**	**131,884**	**119,984**	**108,181**
MOORE COUNTY TOTAL DEMAND	**161,328**	**153,840**	**144,155**	**131,884**	**119,984**	**108,181**
OCHILTREE COUNTY						
CANADIAN BASIN						
BOOKER	7	10	13	17	21	26
PERRYTON	2,829	2,994	3,183	3,401	3,650	3,922
COUNTY-OTHER	239	248	260	278	298	320
MINING	824	853	503	161	23	3
LIVESTOCK	4,216	3,632	3,729	3,832	3,942	4,058
IRRIGATION	57,243	53,825	49,414	43,923	38,433	32,942
CANADIAN BASIN TOTAL DEMAND	**65,358**	**61,562**	**57,102**	**51,612**	**46,367**	**41,271**
OCHILTREE COUNTY TOTAL DEMAND	**65,358**	**61,562**	**57,102**	**51,612**	**46,367**	**41,271**
OLDHAM COUNTY						
CANADIAN BASIN						
VEGA	272	285	281	279	279	279
COUNTY-OTHER	302	315	312	312	311	311
MINING	456	540	613	644	708	776
LIVESTOCK	909	911	913	915	917	920
IRRIGATION	3,071	2,939	2,749	2,444	2,138	1,833
CANADIAN BASIN TOTAL DEMAND	**5,010**	**4,990**	**4,868**	**4,594**	**4,353**	**4,119**
RED BASIN						
COUNTY-OTHER	73	77	76	76	76	76
MINING	19	23	26	27	29	32
LIVESTOCK	320	320	321	322	323	323
IRRIGATION	866	829	775	689	603	517

Water User Group (WUG) Demand

REGION A	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
OLDHAM COUNTY						
RED BASIN TOTAL DEMAND	**1,278**	**1,249**	**1,198**	**1,114**	**1,031**	**948**
OLDHAM COUNTY TOTAL DEMAND	**6,288**	**6,239**	**6,066**	**5,708**	**5,384**	**5,067**
POTTER COUNTY						
CANADIAN BASIN						
AMARILLO	15,884	17,294	18,856	20,510	22,424	24,462
COUNTY-OTHER	1,971	2,146	2,342	2,547	2,784	3,036
MANUFACTURING	1,457	1,569	1,679	1,773	1,904	2,043
MINING	640	781	912	988	1,109	1,245
STEAM ELECTRIC POWER	25,387	26,804	28,408	30,011	34,115	37,669
LIVESTOCK	399	400	402	403	405	408
IRRIGATION	1,679	1,613	1,514	1,346	1,178	1,010
CANADIAN BASIN TOTAL DEMAND	**47,417**	**50,607**	**54,113**	**57,578**	**63,919**	**69,873**
RED BASIN						
AMARILLO	10,458	11,386	12,414	13,504	14,764	16,106
COUNTY-OTHER	1,112	1,210	1,320	1,436	1,569	1,712
MANUFACTURING	8,256	8,892	9,512	10,050	10,787	11,579
MINING	301	368	429	465	522	586
LIVESTOCK	82	82	82	83	83	83
IRRIGATION	1,748	1,679	1,577	1,402	1,226	1,051
RED BASIN TOTAL DEMAND	**21,957**	**23,617**	**25,334**	**26,940**	**28,951**	**31,117**
POTTER COUNTY TOTAL DEMAND	**69,374**	**74,224**	**79,447**	**84,518**	**92,870**	**100,990**
RANDALL COUNTY						
RED BASIN						
AMARILLO	21,389	23,430	25,540	27,846	30,443	33,171
CANYON	3,633	3,982	4,343	4,736	5,179	5,643
HAPPY	11	12	13	14	15	16
LAKE TANGLEWOOD	319	315	312	311	310	310
COUNTY-OTHER	3,665	4,002	4,359	4,748	5,187	5,651
MANUFACTURING	589	638	684	722	784	852
LIVESTOCK	2,654	2,665	2,677	2,690	2,704	2,719
IRRIGATION	18,000	17,156	15,976	14,201	12,426	10,650
RED BASIN TOTAL DEMAND	**50,260**	**52,200**	**53,904**	**55,268**	**57,048**	**59,012**
RANDALL COUNTY TOTAL DEMAND	**50,260**	**52,200**	**53,904**	**55,268**	**57,048**	**59,012**
ROBERTS COUNTY						
CANADIAN BASIN						
MIAMI	224	225	223	222	222	222
COUNTY-OTHER	48	50	48	48	48	48
MINING	1,457	1,010	593	183	19	2
LIVESTOCK	359	359	360	361	362	363
IRRIGATION	5,660	5,329	4,897	4,353	3,809	3,265
CANADIAN BASIN TOTAL DEMAND	**7,748**	**6,973**	**6,121**	**5,167**	**4,460**	**3,900**
RED BASIN						
COUNTY-OTHER	1	1	1	1	1	1
MINING	45	31	18	6	1	0
LIVESTOCK	10	10	10	10	10	10
IRRIGATION	298	280	258	229	200	172

Water User Group (WUG) Demand

REGION A	WUG DEMAND (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ROBERTS COUNTY						
RED BASIN TOTAL DEMAND	**354**	**322**	**287**	**246**	**212**	**183**
ROBERTS COUNTY TOTAL DEMAND	**8,102**	**7,295**	**6,408**	**5,413**	**4,672**	**4,083**
SHERMAN COUNTY						
CANADIAN BASIN						
STRATFORD	470	498	510	524	536	546
COUNTY-OTHER	184	194	197	204	208	212
MINING	35	207	151	98	44	20
LIVESTOCK	3,449	3,631	3,825	4,034	4,257	4,497
IRRIGATION	220,966	207,757	190,687	169,499	148,312	127,125
CANADIAN BASIN TOTAL DEMAND	**225,104**	**212,287**	**195,370**	**174,359**	**153,357**	**132,400**
SHERMAN COUNTY TOTAL DEMAND	**225,104**	**212,287**	**195,370**	**174,359**	**153,357**	**132,400**
WHEELER COUNTY						
RED BASIN						
SHAMROCK	350	353	357	369	383	398
WHEELER	507	520	533	549	569	592
COUNTY-OTHER	290	291	293	302	313	325
MINING	3,268	2,329	1,413	503	139	119
LIVESTOCK	1,577	1,680	1,682	1,684	1,687	1,689
IRRIGATION	8,203	7,983	7,433	6,607	5,781	4,955
RED BASIN TOTAL DEMAND	**14,195**	**13,156**	**11,711**	**10,014**	**8,872**	**8,078**
WHEELER COUNTY TOTAL DEMAND	**14,195**	**13,156**	**11,711**	**10,014**	**8,872**	**8,078**
REGION A TOTAL DEMAND	**1,733,659**	**1,658,045**	**1,554,977**	**1,421,114**	**1,292,717**	**1,166,209**

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
ARMSTRONG COUNTY							
RED BASIN							
CLAUDE	A | OGALLALA AQUIFER | ARMSTRONG COUNTY	463	405	354	311	273	235
COUNTY-OTHER	A | DOCKUM AQUIFER | ARMSTRONG COUNTY	16	16	16	16	16	16
COUNTY-OTHER	A | OGALLALA AQUIFER | ARMSTRONG COUNTY	84	84	84	84	84	84
LIVESTOCK	A | OGALLALA AQUIFER | ARMSTRONG COUNTY	493	497	500	504	507	511
LIVESTOCK	A | OTHER AQUIFER FRESH/BRACKISH | ARMSTRONG COUNTY	30	30	30	30	30	30
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	122	122	122	122	122	122
IRRIGATION	A | OGALLALA AQUIFER | ARMSTRONG COUNTY	4,194	3,990	3,708	3,296	2,884	2,472
RED BASIN TOTAL EXISTING SUPPLY		**5,402**	**5,144**	**4,814**	**4,363**	**3,916**	**3,470**
ARMSTRONG COUNTY TOTAL EXISTING SUPPLY		**5,402**	**5,144**	**4,814**	**4,363**	**3,916**	**3,470**
CARSON COUNTY							
CANADIAN BASIN							
WHITE DEER	A | OGALLALA AQUIFER | CARSON COUNTY	106	107	107	107	107	107
COUNTY-OTHER	A | OGALLALA AQUIFER | CARSON COUNTY	249	237	228	225	208	185
MANUFACTURING	A | OGALLALA AQUIFER | CARSON COUNTY	25	28	30	32	35	37
MINING	A | OGALLALA AQUIFER | CARSON COUNTY	14	14	14	14	14	14
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	59	59	59	59	59	59
LIVESTOCK	A | OGALLALA AQUIFER | CARSON COUNTY	460	463	466	469	473	476
IRRIGATION	A | OGALLALA AQUIFER | CARSON COUNTY	14,483	13,738	12,682	11,273	9,864	8,454
CANADIAN BASIN TOTAL EXISTING SUPPLY		**15,396**	**14,646**	**13,586**	**12,179**	**10,760**	**9,332**
RED BASIN							
GROOM	A | OGALLALA AQUIFER | CARSON COUNTY	326	342	344	338	326	314
PANHANDLE	A | OGALLALA AQUIFER | CARSON COUNTY	483	60	0	0	0	0
WHITE DEER	A | OGALLALA AQUIFER | CARSON COUNTY	138	141	141	140	140	140
COUNTY-OTHER	A | OGALLALA AQUIFER | CARSON COUNTY	215	205	197	194	180	160
MANUFACTURING	A | OGALLALA AQUIFER | CARSON COUNTY	1,102	995	927	871	824	777
LIVESTOCK	A | OGALLALA AQUIFER | CARSON COUNTY	98	99	100	101	102	103
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	75	75	75	75	75	75
IRRIGATION	A | DIRECT REUSE	57	58	58	58	58	58
IRRIGATION	A | OGALLALA AQUIFER | CARSON COUNTY	40,885	38,765	35,759	31,748	27,738	23,728
IRRIGATION	A | RED RUN-OF-RIVER	277	277	277	277	277	277
RED BASIN TOTAL EXISTING SUPPLY		**43,656**	**41,017**	**37,878**	**33,802**	**29,720**	**25,632**
CARSON COUNTY TOTAL EXISTING SUPPLY		**59,052**	**55,663**	**51,464**	**45,981**	**40,480**	**34,964**
CHILDRESS COUNTY							
RED BASIN							
CHILDRESS	A | GREENBELT LAKE/RESERVOIR	1,087	1,161	1,228	1,301	1,379	1,457
CHILDRESS	A | OGALLALA AQUIFER | DONLEY COUNTY	537	497	458	421	389	357
COUNTY-OTHER	A | GREENBELT LAKE/RESERVOIR	119	129	138	147	156	164
COUNTY-OTHER	A | OGALLALA AQUIFER | DONLEY COUNTY	59	55	51	47	44	40
COUNTY-OTHER	A | OTHER AQUIFER FRESH/BRACKISH | CHILDRESS COUNTY	20	20	20	20	20	20
COUNTY-OTHER	A | SEYMOUR AQUIFER | CHILDRESS COUNTY	20	20	20	20	20	20
LIVESTOCK	A | BLAINE AQUIFER | CHILDRESS COUNTY	216	216	216	216	216	216

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
CHILDRESS COUNTY							
RED BASIN							
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	49	49	49	49	49	49
LIVESTOCK	A | SEYMOUR AQUIFER | CHILDRESS COUNTY	240	240	240	240	240	240
IRRIGATION	A | BLAINE AQUIFER | CHILDRESS COUNTY	6,995	6,713	6,288	5,555	4,821	4,088
IRRIGATION	A | DIRECT REUSE	162	166	169	172	177	181
IRRIGATION	A | OTHER AQUIFER FRESH/BRACKISH | CHILDRESS COUNTY	213	213	213	213	213	213
IRRIGATION	A | RED RUN-OF-RIVER	19	19	19	19	19	19
IRRIGATION	A | SEYMOUR AQUIFER | CHILDRESS COUNTY	100	100	100	100	100	100
RED BASIN TOTAL EXISTING SUPPLY		**9,836**	**9,598**	**9,209**	**8,520**	**7,843**	**7,164**
CHILDRESS COUNTY TOTAL EXISTING SUPPLY		**9,836**	**9,598**	**9,209**	**8,520**	**7,843**	**7,164**
COLLINGSWORTH COUNTY							
RED BASIN							
WELLINGTON	A | SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	0	0	0	0	0	0
COUNTY-OTHER	A | BLAINE AQUIFER | COLLINGSWORTH COUNTY	8	8	8	8	8	8
COUNTY-OTHER	A | OTHER AQUIFER FRESH/BRACKISH | COLLINGSWORTH COUNTY	25	25	25	25	25	25
COUNTY-OTHER	A | SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	204	204	204	204	204	204
LIVESTOCK	A | BLAINE AQUIFER | COLLINGSWORTH COUNTY	275	275	275	283	283	283
LIVESTOCK	A | OTHER AQUIFER FRESH/BRACKISH | COLLINGSWORTH COUNTY	276	276	276	276	276	276
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	29	29	29	29	29	29
LIVESTOCK	A | SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	26	26	26	26	26	26
IRRIGATION	A | BLAINE AQUIFER | COLLINGSWORTH COUNTY	8,972	8,638	8,128	7,225	6,322	5,419
IRRIGATION	A | DIRECT REUSE	53	54	55	57	58	60
IRRIGATION	A | OTHER AQUIFER FRESH/BRACKISH | COLLINGSWORTH COUNTY	8	8	8	8	8	8
IRRIGATION	A | RED RUN-OF-RIVER	851	851	851	851	851	851
IRRIGATION	A | SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	8,972	8,638	8,128	7,225	6,322	5,419
RED BASIN TOTAL EXISTING SUPPLY		**19,699**	**19,032**	**18,013**	**16,217**	**14,412**	**12,608**
COLLINGSWORTH COUNTY TOTAL EXISTING SUPPLY		**19,699**	**19,032**	**18,013**	**16,217**	**14,412**	**12,608**
DALLAM COUNTY							
CANADIAN BASIN							
DALHART	A | OGALLALA-RITA BLANCA AQUIFER | DALLAM COUNTY	1,306	1,220	1,112	993	872	744
TEXLINE	A | OGALLALA-RITA BLANCA AQUIFER | DALLAM COUNTY	227	253	280	262	236	201
COUNTY-OTHER	A | OGALLALA-RITA BLANCA AQUIFER | DALLAM COUNTY	141	151	166	183	199	214
MANUFACTURING	A | OGALLALA-RITA BLANCA AQUIFER | DALLAM COUNTY	9	9	10	10	11	11
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	2,488	2,488	2,488	2,488	2,488	2,488
LIVESTOCK	A | OGALLALA-RITA BLANCA AQUIFER | DALLAM COUNTY	1,949	2,181	2,432	2,703	2,997	3,315
IRRIGATION	A | DOCKUM AQUIFER | DALLAM COUNTY	3,026	3,026	3,026	3,026	3,026	3,026
IRRIGATION	A | OGALLALA-RITA BLANCA AQUIFER | DALLAM COUNTY	287,439	252,823	221,543	192,895	167,090	141,286
CANADIAN BASIN TOTAL EXISTING SUPPLY		**296,585**	**262,151**	**231,057**	**202,560**	**176,919**	**151,285**

Water User Group (WUG) Existing Water Supply

REGION A		EXISTING SUPPLY (ACRE-FEET PER YEAR)					
	SOURCE REGION | SOURCE NAME	2020	2030	2040	2050	2060	2070
DALLAM COUNTY TOTAL EXISTING SUPPLY		**296,585**	**262,151**	**231,057**	**202,560**	**176,919**	**151,285**
DONLEY COUNTY							
RED BASIN							
CLARENDON	A | GREENBELT LAKE/RESERVOIR	253	258	263	269	278	286
CLARENDON	A | OGALLALA AQUIFER | DONLEY COUNTY	125	111	98	87	78	70
COUNTY-OTHER	A | GREENBELT LAKE/RESERVOIR	64	66	69	72	74	76
COUNTY-OTHER	A | OGALLALA AQUIFER | DONLEY COUNTY	201	199	196	193	191	189
LIVESTOCK	A | OGALLALA AQUIFER | DONLEY COUNTY	664	666	667	669	671	673
LIVESTOCK	A | OTHER AQUIFER FRESH/BRACKISH | DONLEY COUNTY	383	383	383	383	383	383
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	283	283	283	283	283	283
IRRIGATION	A | OGALLALA AQUIFER | DONLEY COUNTY	24,080	23,203	21,847	19,419	16,992	14,564
IRRIGATION	A | RED RUN-OF-RIVER	166	166	166	166	166	166
RED BASIN TOTAL EXISTING SUPPLY		**26,219**	**25,335**	**23,972**	**21,541**	**19,116**	**16,690**
DONLEY COUNTY TOTAL EXISTING SUPPLY		**26,219**	**25,335**	**23,972**	**21,541**	**19,116**	**16,690**
GRAY COUNTY							
CANADIAN BASIN							
PAMPA	A | OGALLALA AQUIFER | GRAY COUNTY	1,531	1,224	976	791	637	483
PAMPA	A | OGALLALA AQUIFER | ROBERTS COUNTY	2,484	1,015	893	1,945	1,755	1,566
COUNTY-OTHER	A | OGALLALA AQUIFER | GRAY COUNTY	450	488	537	604	659	717
MANUFACTURING	A | OGALLALA AQUIFER | GRAY COUNTY	4,371	4,370	4,465	4,465	4,275	4,085
MINING	A | OGALLALA AQUIFER | GRAY COUNTY	7	7	7	6	5	5
STEAM ELECTRIC POWER	A | OGALLALA AQUIFER | GRAY COUNTY	1,409	2,112	2,299	2,952	3,087	3,320
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	199	199	199	199	199	199
LIVESTOCK	A | OGALLALA AQUIFER | GRAY COUNTY	141	141	141	141	141	141
IRRIGATION	A | CANADIAN RUN-OF-RIVER	1	1	1	1	1	1
IRRIGATION	A | DIRECT REUSE	220	220	220	220	220	220
IRRIGATION	A | OGALLALA AQUIFER | GRAY COUNTY	5,315	5,006	4,599	4,064	3,528	2,992
CANADIAN BASIN TOTAL EXISTING SUPPLY		**16,128**	**14,783**	**14,337**	**15,388**	**14,507**	**13,729**
RED BASIN							
MCLEAN	A | OGALLALA AQUIFER | GRAY COUNTY	245	240	244	185	164	144
COUNTY-OTHER	A | OGALLALA AQUIFER | GRAY COUNTY	243	264	290	326	356	388
MANUFACTURING	A | OGALLALA AQUIFER | GRAY COUNTY	229	230	235	235	225	215
MINING	A | OGALLALA AQUIFER | GRAY COUNTY	68	67	60	54	48	42
LIVESTOCK	A | OGALLALA AQUIFER | GRAY COUNTY	1,174	1,174	1,174	1,174	1,174	1,174
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	600	600	600	600	600	600
IRRIGATION	A | OGALLALA AQUIFER | GRAY COUNTY	15,700	14,822	13,664	12,139	10,615	9,091
IRRIGATION	A | RED RUN-OF-RIVER	55	55	55	55	55	55
RED BASIN TOTAL EXISTING SUPPLY		**18,314**	**17,452**	**16,322**	**14,768**	**13,237**	**11,709**
GRAY COUNTY TOTAL EXISTING SUPPLY		**34,442**	**32,235**	**30,659**	**30,156**	**27,744**	**25,438**
HALL COUNTY							
RED BASIN							
MEMPHIS	A | GREENBELT LAKE/RESERVOIR	67	70	73	76	78	80
MEMPHIS	A | OGALLALA AQUIFER | DONLEY COUNTY	361	324	299	226	191	156

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
HALL COUNTY							
RED BASIN							
COUNTY-OTHER	A | GREENBELT LAKE/RESERVOIR	62	64	67	69	72	74
COUNTY-OTHER	A | OGALLALA AQUIFER | DONLEY COUNTY	115	113	110	108	105	103
COUNTY-OTHER	A | SEYMOUR AQUIFER | HALL COUNTY	142	142	142	142	142	142
LIVESTOCK	A | OTHER AQUIFER FRESH/BRACKISH | HALL COUNTY	300	300	300	300	300	300
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	91	91	91	91	91	91
LIVESTOCK	A | SEYMOUR AQUIFER | HALL COUNTY	15	15	15	15	15	15
IRRIGATION	A | DIRECT REUSE	100	100	100	100	100	100
IRRIGATION	A | OTHER AQUIFER FRESH/BRACKISH | HALL COUNTY	786	786	786	786	721	618
IRRIGATION	A | RED RUN-OF-RIVER	52	52	52	52	52	52
IRRIGATION	A | SEYMOUR AQUIFER | HALL COUNTY	9,196	8,868	8,336	7,305	6,340	5,412
RED BASIN TOTAL EXISTING SUPPLY		**11,287**	**10,925**	**10,371**	**9,270**	**8,207**	**7,143**
HALL COUNTY TOTAL EXISTING SUPPLY		**11,287**	**10,925**	**10,371**	**9,270**	**8,207**	**7,143**
HANSFORD COUNTY							
CANADIAN BASIN							
GRUVER	A | OGALLALA AQUIFER | HANSFORD COUNTY	371	338	249	184	132	81
SPEARMAN	A | OGALLALA AQUIFER | HANSFORD COUNTY	672	683	691	421	258	112
COUNTY-OTHER	A | OGALLALA AQUIFER | HANSFORD COUNTY	200	200	200	200	200	200
MANUFACTURING	A | OGALLALA AQUIFER | HANSFORD COUNTY	90	91	93	101	111	120
MINING	A | OGALLALA AQUIFER | HANSFORD COUNTY	577	904	602	309	16	1
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	2,617	2,617	2,617	2,617	2,617	2,617
LIVESTOCK	A | OGALLALA AQUIFER | HANSFORD COUNTY	815	957	1,107	1,264	1,429	1,602
IRRIGATION	A | CANADIAN RUN-OF-RIVER	22	22	22	22	22	22
IRRIGATION	A | OGALLALA AQUIFER | HANSFORD COUNTY	134,902	126,481	115,759	102,897	90,035	77,173
CANADIAN BASIN TOTAL EXISTING SUPPLY		**140,266**	**132,293**	**121,340**	**108,015**	**94,820**	**81,928**
HANSFORD COUNTY TOTAL EXISTING SUPPLY		**140,266**	**132,293**	**121,340**	**108,015**	**94,820**	**81,928**
HARTLEY COUNTY							
CANADIAN BASIN							
DALHART	A | OGALLALA-RITA BLANCA AQUIFER | DALLAM COUNTY	614	530	440	361	294	234
COUNTY-OTHER	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	655	687	700	711	725	737
MANUFACTURING	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	5	5	5	5	5	5
MINING	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	7	7	6	5	4	3
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	3,193	3,193	3,193	3,193	3,193	3,193
LIVESTOCK	A | DOCKUM AQUIFER | HARTLEY COUNTY	1,161	1,161	1,161	1,161	1,161	1,161
LIVESTOCK	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	2,144	2,623	3,144	3,712	4,330	5,005
IRRIGATION	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	268,060	232,514	201,640	174,225	150,144	126,063
CANADIAN BASIN TOTAL EXISTING SUPPLY		**275,839**	**240,720**	**210,289**	**183,373**	**159,856**	**136,401**
HARTLEY COUNTY TOTAL EXISTING SUPPLY		**275,839**	**240,720**	**210,289**	**183,373**	**159,856**	**136,401**

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
HEMPHILL COUNTY							
CANADIAN BASIN							
CANADIAN	A | OGALLALA AQUIFER | HEMPHILL COUNTY	786	866	934	1,009	1,079	1,145
COUNTY-OTHER	A | OGALLALA AQUIFER | HEMPHILL COUNTY	132	132	132	132	132	132
MANUFACTURING	A | OGALLALA AQUIFER | HEMPHILL COUNTY	6	6	6	6	6	6
MINING	A | OGALLALA AQUIFER | HEMPHILL COUNTY	926	705	498	293	89	27
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	248	248	248	248	248	248
LIVESTOCK	A | OGALLALA AQUIFER | HEMPHILL COUNTY	509	512	515	518	521	525
IRRIGATION	A | OGALLALA AQUIFER | HEMPHILL COUNTY	1,316	1,251	1,162	1,033	904	775
CANADIAN BASIN TOTAL EXISTING SUPPLY		**3,923**	**3,720**	**3,495**	**3,239**	**2,979**	**2,858**
RED BASIN							
COUNTY-OTHER	A | OGALLALA AQUIFER | HEMPHILL COUNTY	90	90	90	90	90	90
MINING	A | OGALLALA AQUIFER | HEMPHILL COUNTY	1,388	1,058	746	439	134	41
LIVESTOCK	A | OGALLALA AQUIFER | HEMPHILL COUNTY	345	346	348	350	353	356
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	173	173	173	173	173	173
IRRIGATION	A | OGALLALA AQUIFER | HEMPHILL COUNTY	591	563	523	465	407	349
RED BASIN TOTAL EXISTING SUPPLY		**2,587**	**2,230**	**1,880**	**1,517**	**1,157**	**1,009**
HEMPHILL COUNTY TOTAL EXISTING SUPPLY		**6,510**	**5,950**	**5,375**	**4,756**	**4,136**	**3,867**
HUTCHINSON COUNTY							
CANADIAN BASIN							
BORGER	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	794	594	643	648	528	434
BORGER	A | OGALLALA AQUIFER | ROBERTS COUNTY	2,329	2,129	1,639	1,238	1,050	863
FRITCH	A | OGALLALA AQUIFER | CARSON COUNTY	437	441	436	434	433	433
STINNETT	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	501	467	448	332	281	230
TCW SUPPLY INC	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	663	504	379	284	214	180
COUNTY-OTHER	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	455	448	441	433	426	421
MANUFACTURING	A | CANADIAN RUN-OF-RIVER	2	2	2	2	2	2
MANUFACTURING	A | DIRECT REUSE	1,045	1,045	1,045	1,045	1,045	1,045
MANUFACTURING	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	22,810	23,220	23,663	24,122	25,406	26,778
MANUFACTURING	A | OGALLALA AQUIFER | ROBERTS COUNTY	1,500	1,700	1,800	1,700	1,600	1,500
MINING	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	184	231	170	113	56	34
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	281	281	281	281	281	281
LIVESTOCK	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	566	592	622	654	690	729
IRRIGATION	A | CANADIAN RUN-OF-RIVER	96	96	96	96	96	96
IRRIGATION	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	40,008	37,671	34,635	30,786	26,938	23,090
CANADIAN BASIN TOTAL EXISTING SUPPLY		**71,671**	**69,421**	**66,300**	**62,168**	**59,046**	**56,116**
HUTCHINSON COUNTY TOTAL EXISTING SUPPLY		**71,671**	**69,421**	**66,300**	**62,168**	**59,046**	**56,116**
LIPSCOMB COUNTY							
CANADIAN BASIN							
BOOKER	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	496	547	499	361	300	240
COUNTY-OTHER	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	473	473	473	473	473	473
MANUFACTURING	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	147	155	140	98	83	69
MINING	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	1,098	758	446	142	21	3
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	110	110	110	110	110	110

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
LIPSCOMB COUNTY							
CANADIAN BASIN							
LIVESTOCK	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	837	859	883	910	940	973
IRRIGATION	A | CANADIAN RUN-OF-RIVER	66	66	66	66	66	66
IRRIGATION	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	20,009	19,014	17,650	15,689	13,728	11,767
CANADIAN BASIN TOTAL EXISTING SUPPLY		**23,236**	**21,982**	**20,267**	**17,849**	**15,721**	**13,701**
LIPSCOMB COUNTY TOTAL EXISTING SUPPLY		**23,236**	**21,982**	**20,267**	**17,849**	**15,721**	**13,701**
MOORE COUNTY							
CANADIAN BASIN							
CACTUS	A | OGALLALA AQUIFER | MOORE COUNTY	402	331	268	212	185	156
DUMAS	A | OGALLALA AQUIFER | MOORE COUNTY	1,132	790	573	318	162	7
DUMAS	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	2,116	2,130	2,030	1,869	1,679	1,489
FRITCH	A | OGALLALA AQUIFER | CARSON COUNTY	5	5	5	5	5	5
SUNRAY	A | OGALLALA AQUIFER | MOORE COUNTY	609	330	125	62	18	0
COUNTY-OTHER	A | OGALLALA AQUIFER | MOORE COUNTY	307	332	363	399	444	489
COUNTY-OTHER	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	55	44	36	27	21	15
MANUFACTURING	A | OGALLALA AQUIFER | MOORE COUNTY	7,175	7,203	7,284	6,024	5,032	4,191
MINING	A | OGALLALA AQUIFER | MOORE COUNTY	16	16	16	15	15	15
STEAM ELECTRIC POWER	A | OGALLALA AQUIFER | MOORE COUNTY	200	0	0	0	0	0
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	1,000	1,000	1,000	1,000	1,000	1,000
LIVESTOCK	A | OGALLALA AQUIFER | MOORE COUNTY	2,676	2,906	3,155	3,424	3,716	4,032
IRRIGATION	A | CANADIAN RUN-OF-RIVER	7	7	7	7	7	7
IRRIGATION	A | OGALLALA AQUIFER | MOORE COUNTY	143,028	134,395	123,290	109,591	92,003	76,015
CANADIAN BASIN TOTAL EXISTING SUPPLY		**158,728**	**149,489**	**138,152**	**122,953**	**104,287**	**87,421**
MOORE COUNTY TOTAL EXISTING SUPPLY		**158,728**	**149,489**	**138,152**	**122,953**	**104,287**	**87,421**
OCHILTREE COUNTY							
CANADIAN BASIN							
BOOKER	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	7	10	11	10	10	9
PERRYTON	A | OGALLALA AQUIFER | OCHILTREE COUNTY	2,351	2,031	1,745	1,524	1,309	1,136
COUNTY-OTHER	A | OGALLALA AQUIFER | OCHILTREE COUNTY	263	273	286	306	328	352
MINING	A | OGALLALA AQUIFER | OCHILTREE COUNTY	824	853	503	161	23	3
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	421	421	421	421	421	421
LIVESTOCK	A | OGALLALA AQUIFER | OCHILTREE COUNTY	3,795	3,211	3,308	3,411	3,521	3,637
IRRIGATION	A | OGALLALA AQUIFER | OCHILTREE COUNTY	57,243	53,825	49,414	43,923	38,433	32,942
CANADIAN BASIN TOTAL EXISTING SUPPLY		**64,904**	**60,624**	**55,688**	**49,756**	**44,045**	**38,500**
OCHILTREE COUNTY TOTAL EXISTING SUPPLY		**64,904**	**60,624**	**55,688**	**49,756**	**44,045**	**38,500**
OLDHAM COUNTY							
CANADIAN BASIN							
VEGA	A | OGALLALA AQUIFER | OLDHAM COUNTY	90	90	90	90	90	90
VEGA	O | OGALLALA AQUIFER | DEAF SMITH COUNTY	200	200	200	200	200	200
COUNTY-OTHER	A | DOCKUM AQUIFER | OLDHAM COUNTY	387	387	387	387	387	387
COUNTY-OTHER	A | OGALLALA AQUIFER | OLDHAM COUNTY	214	210	211	211	211	211
MINING	A | DOCKUM AQUIFER | OLDHAM COUNTY	283	283	283	283	283	283

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
OLDHAM COUNTY							
CANADIAN BASIN							
MINING	A | OGALLALA AQUIFER | OLDHAM COUNTY	173	257	330	361	425	493
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	626	626	626	626	626	626
LIVESTOCK	A | DOCKUM AQUIFER | OLDHAM COUNTY	430	430	430	430	430	430
LIVESTOCK	A | OGALLALA AQUIFER | OLDHAM COUNTY	356	356	356	356	356	356
IRRIGATION	A | DOCKUM AQUIFER | OLDHAM COUNTY	372	372	372	372	372	372
IRRIGATION	A | OGALLALA AQUIFER | OLDHAM COUNTY	2,699	2,567	2,377	2,072	1,766	1,461
CANADIAN BASIN TOTAL EXISTING SUPPLY		**5,830**	**5,778**	**5,662**	**5,388**	**5,146**	**4,909**
RED BASIN							
COUNTY-OTHER	A | OGALLALA AQUIFER | OLDHAM COUNTY	73	77	76	76	76	76
MINING	A | OGALLALA AQUIFER | OLDHAM COUNTY	19	23	26	27	29	32
LIVESTOCK	A | OGALLALA AQUIFER | OLDHAM COUNTY	119	119	119	119	119	119
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	209	209	209	209	209	209
IRRIGATION	A | OGALLALA AQUIFER | OLDHAM COUNTY	866	829	775	689	603	517
RED BASIN TOTAL EXISTING SUPPLY		**1,286**	**1,257**	**1,205**	**1,120**	**1,036**	**953**
OLDHAM COUNTY TOTAL EXISTING SUPPLY		**7,116**	**7,035**	**6,867**	**6,508**	**6,182**	**5,862**
POTTER COUNTY							
CANADIAN BASIN							
AMARILLO	A | OGALLALA AQUIFER | CARSON COUNTY	3,643	3,112	2,617	2,211	1,911	1,610
AMARILLO	A | OGALLALA AQUIFER | POTTER COUNTY	3,151	2,452	2,364	2,233	2,056	1,879
AMARILLO	A | OGALLALA AQUIFER | RANDALL COUNTY	753	576	455	365	295	225
AMARILLO	A | OGALLALA AQUIFER | ROBERTS COUNTY	6,803	6,992	6,146	5,279	4,931	4,433
AMARILLO	O | OGALLALA AQUIFER | DEAF SMITH COUNTY	33	33	33	33	16	0
COUNTY-OTHER	A | DOCKUM AQUIFER | POTTER COUNTY	900	900	900	900	900	900
COUNTY-OTHER	A | OGALLALA AQUIFER | POTTER COUNTY	800	800	800	800	800	800
MANUFACTURING	A | OGALLALA AQUIFER | POTTER COUNTY	219	191	169	154	137	122
MANUFACTURING	A | OGALLALA AQUIFER | ROBERTS COUNTY	924	836	724	612	547	476
MINING	A | OGALLALA AQUIFER | POTTER COUNTY	640	781	912	988	1,109	1,245
STEAM ELECTRIC POWER	A | DIRECT REUSE	25,387	26,804	28,408	30,011	34,115	37,669
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	500	500	500	500	500	500
LIVESTOCK	A | DOCKUM AQUIFER | POTTER COUNTY	13	13	13	13	13	13
LIVESTOCK	A | OGALLALA AQUIFER | POTTER COUNTY	50	50	50	50	50	50
IRRIGATION	A | DIRECT REUSE	555	617	711	760	727	700
IRRIGATION	A | OGALLALA AQUIFER | POTTER COUNTY	1,305	1,033	803	586	451	317
CANADIAN BASIN TOTAL EXISTING SUPPLY		**45,676**	**45,690**	**45,605**	**45,495**	**48,558**	**50,939**
RED BASIN							
AMARILLO	A | OGALLALA AQUIFER | CARSON COUNTY	2,399	2,049	1,722	1,456	1,257	1,059
AMARILLO	A | OGALLALA AQUIFER | POTTER COUNTY	2,074	1,614	1,557	1,470	1,353	1,237
AMARILLO	A | OGALLALA AQUIFER | RANDALL COUNTY	496	379	300	240	194	149
AMARILLO	A | OGALLALA AQUIFER | ROBERTS COUNTY	4,480	4,603	4,046	3,476	3,246	2,919
AMARILLO	O | OGALLALA AQUIFER | DEAF SMITH COUNTY	22	22	22	22	11	0
COUNTY-OTHER	A | OGALLALA AQUIFER | POTTER COUNTY	700	700	700	700	700	500

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
POTTER COUNTY							
RED BASIN							
MANUFACTURING	A | OGALLALA AQUIFER | POTTER COUNTY	1,238	1,085	957	871	776	692
MANUFACTURING	A | OGALLALA AQUIFER | ROBERTS COUNTY	5,233	4,738	4,102	3,472	3,101	2,699
MINING	A | OGALLALA AQUIFER | POTTER COUNTY	301	368	429	465	522	586
LIVESTOCK	A | OGALLALA AQUIFER | POTTER COUNTY	50	50	50	50	50	50
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	62	62	62	62	62	62
IRRIGATION	A | DIRECT REUSE	1,645	1,583	1,489	1,440	1,473	1,500
IRRIGATION	A | OGALLALA AQUIFER | POTTER COUNTY	103	96	89	83	76	70
RED BASIN TOTAL EXISTING SUPPLY		**18,803**	**17,349**	**15,525**	**13,807**	**12,821**	**11,523**
POTTER COUNTY TOTAL EXISTING SUPPLY		**64,479**	**63,039**	**61,130**	**59,302**	**61,379**	**62,462**
RANDALL COUNTY							
RED BASIN							
AMARILLO	A | OGALLALA AQUIFER | CARSON COUNTY	4,906	4,217	3,544	3,002	2,592	2,181
AMARILLO	A | OGALLALA AQUIFER | POTTER COUNTY	4,242	3,322	3,202	3,032	2,790	2,548
AMARILLO	A | OGALLALA AQUIFER | RANDALL COUNTY	1,014	780	617	495	401	306
AMARILLO	A | OGALLALA AQUIFER | ROBERTS COUNTY	9,162	9,473	8,325	7,167	6,693	6,011
AMARILLO	O | OGALLALA AQUIFER | DEAF SMITH COUNTY	45	45	45	45	23	0
CANYON	A | DOCKUM AQUIFER | RANDALL COUNTY	218	207	197	187	178	169
CANYON	A | OGALLALA AQUIFER | RANDALL COUNTY	1,500	1,425	1,354	1,286	1,222	1,161
CANYON	A | OGALLALA AQUIFER | ROBERTS COUNTY	906	761	616	493	0	0
HAPPY	A | DOCKUM AQUIFER | RANDALL COUNTY	5	5	6	6	6	7
HAPPY	O | OGALLALA AQUIFER | SWISHER COUNTY	10	12	12	13	12	10
LAKE TANGLEWOOD	A | OGALLALA AQUIFER | RANDALL COUNTY	147	115	87	63	44	26
COUNTY-OTHER	A | DOCKUM AQUIFER | RANDALL COUNTY	689	689	689	689	689	689
COUNTY-OTHER	A | OGALLALA AQUIFER | RANDALL COUNTY	2,316	2,316	2,316	2,316	2,316	2,316
COUNTY-OTHER	A | OGALLALA AQUIFER | ROBERTS COUNTY	23	19	15	12	10	8
MANUFACTURING	A | OGALLALA AQUIFER | RANDALL COUNTY	50	50	50	50	50	50
MANUFACTURING	A | OGALLALA AQUIFER | ROBERTS COUNTY	498	419	339	271	226	183
LIVESTOCK	A | DOCKUM AQUIFER | RANDALL COUNTY	230	230	230	230	230	230
LIVESTOCK	A | OGALLALA AQUIFER | RANDALL COUNTY	1,112	1,123	1,135	1,148	1,162	1,177
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	1,312	1,312	1,312	1,312	1,312	1,312
IRRIGATION	A | DIRECT REUSE	545	597	651	710	777	846
IRRIGATION	A | OGALLALA AQUIFER | RANDALL COUNTY	18,000	17,156	15,976	14,201	12,426	10,650
IRRIGATION	A | RED RUN-OF-RIVER	217	217	217	217	217	217
RED BASIN TOTAL EXISTING SUPPLY		**47,147**	**44,490**	**40,935**	**36,945**	**33,376**	**30,097**
RANDALL COUNTY TOTAL EXISTING SUPPLY		**47,147**	**44,490**	**40,935**	**36,945**	**33,376**	**30,097**
ROBERTS COUNTY							
CANADIAN BASIN							
MIAMI	A | OGALLALA AQUIFER | ROBERTS COUNTY	541	541	541	459	393	326
COUNTY-OTHER	A | OGALLALA AQUIFER | ROBERTS COUNTY	60	60	60	60	60	60
MINING	A | OGALLALA AQUIFER | ROBERTS COUNTY	1,457	1,010	593	183	19	2
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	124	124	124	124	124	124

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR)					
		2020	**2030**	**2040**	**2050**	**2060**	**2070**
ROBERTS COUNTY							
CANADIAN BASIN							
LIVESTOCK	A | OGALLALA AQUIFER | ROBERTS COUNTY	338	338	338	338	338	338
IRRIGATION	A | CANADIAN RUN-OF-RIVER	72	72	72	72	72	72
IRRIGATION	A | OGALLALA AQUIFER | ROBERTS COUNTY	5,588	5,257	4,825	4,281	3,737	3,193
CANADIAN BASIN TOTAL EXISTING SUPPLY		**8,180**	**7,402**	**6,553**	**5,517**	**4,743**	**4,115**
RED BASIN							
COUNTY-OTHER	A | OGALLALA AQUIFER | ROBERTS COUNTY	5	5	5	5	5	5
MINING	A | OGALLALA AQUIFER | ROBERTS COUNTY	45	31	18	6	1	0
LIVESTOCK	A | OGALLALA AQUIFER | ROBERTS COUNTY	10	10	10	10	10	10
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	15	15	15	15	15	15
IRRIGATION	A | OGALLALA AQUIFER | ROBERTS COUNTY	298	280	258	229	200	172
RED BASIN TOTAL EXISTING SUPPLY		**373**	**341**	**306**	**265**	**231**	**202**
ROBERTS COUNTY TOTAL EXISTING SUPPLY		**8,553**	**7,743**	**6,859**	**5,782**	**4,974**	**4,317**
SHERMAN COUNTY							
CANADIAN BASIN							
STRATFORD	A | OGALLALA AQUIFER | SHERMAN COUNTY	1,251	1,251	1,251	1,107	920	733
COUNTY-OTHER	A | OGALLALA AQUIFER | SHERMAN COUNTY	184	194	197	204	208	212
MINING	A | OGALLALA AQUIFER | SHERMAN COUNTY	35	207	151	98	44	20
LIVESTOCK	A | CANADIAN LIVESTOCK LOCAL SUPPLY	1,052	1,052	1,052	1,052	1,052	1,052
LIVESTOCK	A | OGALLALA AQUIFER | SHERMAN COUNTY	2,397	2,579	2,773	2,982	3,205	3,445
IRRIGATION	A | CANADIAN RUN-OF-RIVER	32	32	32	32	32	32
IRRIGATION	A | OGALLALA AQUIFER | SHERMAN COUNTY	220,966	207,757	190,687	169,499	148,312	127,125
CANADIAN BASIN TOTAL EXISTING SUPPLY		**225,917**	**213,072**	**196,143**	**174,974**	**153,773**	**132,619**
SHERMAN COUNTY TOTAL EXISTING SUPPLY		**225,917**	**213,072**	**196,143**	**174,974**	**153,773**	**132,619**
WHEELER COUNTY							
RED BASIN							
SHAMROCK	A | OGALLALA AQUIFER | WHEELER COUNTY	957	912	872	820	765	710
WHEELER	A | OGALLALA AQUIFER | WHEELER COUNTY	323	271	225	184	157	139
COUNTY-OTHER	A | BLAINE AQUIFER | WHEELER COUNTY	15	15	15	15	15	15
COUNTY-OTHER	A | OGALLALA AQUIFER | WHEELER COUNTY	348	348	348	348	348	348
COUNTY-OTHER	A | OTHER AQUIFER FRESH/BRACKISH | WHEELER COUNTY	22	22	22	22	22	22
MINING	A | OGALLALA AQUIFER | WHEELER COUNTY	3,268	2,329	1,413	503	139	119
LIVESTOCK	A | BLAINE AQUIFER | WHEELER COUNTY	19	19	19	19	19	19
LIVESTOCK	A | OGALLALA AQUIFER | WHEELER COUNTY	803	803	803	803	803	803
LIVESTOCK	A | OTHER AQUIFER FRESH/BRACKISH | WHEELER COUNTY	28	28	28	28	28	28
LIVESTOCK	A | RED LIVESTOCK LOCAL SUPPLY	845	845	845	845	845	845
IRRIGATION	A | BLAINE AQUIFER | WHEELER COUNTY	15	15	15	15	15	15
IRRIGATION	A | DIRECT REUSE	51	52	53	55	57	59
IRRIGATION	A | OGALLALA AQUIFER | WHEELER COUNTY	8,203	7,983	7,433	6,607	5,781	4,955
IRRIGATION	A | OTHER AQUIFER FRESH/BRACKISH | WHEELER COUNTY	226	226	226	226	226	226
IRRIGATION	A | RED RUN-OF-RIVER	603	603	603	603	603	603
RED BASIN TOTAL EXISTING SUPPLY		**15,726**	**14,471**	**12,920**	**11,093**	**9,823**	**8,906**

Water User Group (WUG) Existing Water Supply

REGION A	SOURCE REGION | SOURCE NAME	EXISTING SUPPLY (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
WHEELER COUNTY TOTAL EXISTING SUPPLY		15,726	14,471	12,920	11,093	9,823	8,906
	REGION A TOTAL EXISTING SUPPLY	1,572,614	1,450,412	1,321,824	1,182,082	1,050,055	920,959

Water User Group (WUG) Needs/Surplus

REGION A	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARMSTRONG COUNTY						
RED BASIN						
CLAUDE	105	52	6	(35)	(72)	(110)
COUNTY-OTHER	11	15	16	17	17	17
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
CARSON COUNTY						
CANADIAN BASIN						
WHITE DEER	0	0	0	0	0	0
COUNTY-OTHER	88	76	68	67	51	28
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
GROOM	147	166	170	165	153	141
PANHANDLE	(89)	(521)	(582)	(577)	(576)	(576)
WHITE DEER	0	0	0	0	0	0
COUNTY-OTHER	92	85	77	75	61	41
MANUFACTURING	708	563	458	371	283	190
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
CHILDRESS COUNTY						
RED BASIN						
CHILDRESS	0	0	0	0	0	0
COUNTY-OTHER	20	20	19	18	18	17
LIVESTOCK	15	12	10	8	5	2
IRRIGATION	181	185	188	191	196	200
COLLINGSWORTH COUNTY						
RED BASIN						
WELLINGTON	(525)	(540)	(549)	(567)	(582)	(595)
COUNTY-OTHER	46	40	37	30	25	20
LIVESTOCK	6	3	1	6	3	0
IRRIGATION	913	913	915	917	918	920
DALLAM COUNTY						
CANADIAN BASIN						
DALHART	(509)	(794)	(1,116)	(1,454)	(1,794)	(2,134)
TEXLINE	0	0	0	(46)	(99)	(161)
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(79,399)	(91,675)	(94,226)	(87,452)	(77,836)	(68,218)
DONLEY COUNTY						
RED BASIN						
CLARENDON	0	0	0	0	0	0
COUNTY-OTHER	20	28	35	37	38	38
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	166	166	166	166	166	166

Water User Group (WUG) Needs/Surplus

REGION A	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
GRAY COUNTY						
CANADIAN BASIN						
PAMPA	304	(1,752)	(2,491)	(2,190)	(2,985)	(3,806)
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	238	173	225	208	189	162
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	205	202	199	196	193	189
IRRIGATION	0	0	0	0	0	0
RED BASIN						
MCLEAN	40	18	1	(89)	(135)	(182)
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	12	9	12	11	10	9
MINING	0	0	0	0	0	0
LIVESTOCK	557	534	508	480	448	414
IRRIGATION	0	0	0	0	0	0
HALL COUNTY						
RED BASIN						
MEMPHIS	45	12	0	(68)	(100)	(133)
COUNTY-OTHER	0	(3)	(1)	0	0	0
LIVESTOCK	70	69	67	66	65	63
IRRIGATION	0	0	0	0	0	0
HANSFORD COUNTY						
CANADIAN BASIN						
GRUVER	61	2	(111)	(196)	(272)	(344)
SPEARMAN	0	0	0	(283)	(466)	(634)
COUNTY-OTHER	62	55	43	33	24	14
MANUFACTURING	32	30	30	36	41	46
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	22	22	22	22	22	22
HARTLEY COUNTY						
CANADIAN BASIN						
DALHART	(240)	(344)	(442)	(528)	(605)	(673)
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	(77,305)	(93,368)	(98,650)	(92,699)	(83,415)	(74,130)
HEMPHILL COUNTY						
CANADIAN BASIN						
CANADIAN	0	0	0	0	0	0
COUNTY-OTHER	17	20	23	23	23	23
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	47	45	44	41	38	35

Water User Group (WUG) Needs/Surplus

REGION A	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
HEMPHILL COUNTY						
RED BASIN						
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
HUTCHINSON COUNTY						
CANADIAN BASIN						
BORGER	(92)	(531)	(952)	(1,343)	(1,647)	(1,927)
FRITCH	0	0	0	0	0	0
STINNETT	55	15	0	(115)	(165)	(216)
TCW SUPPLY INC	(75)	(251)	(375)	(466)	(535)	(569)
COUNTY-OTHER	143	129	120	113	106	102
MANUFACTURING	10	(860)	(1,739)	(2,614)	(3,487)	(4,416)
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	96	96	96	96	96	96
LIPSCOMB COUNTY						
CANADIAN BASIN						
BOOKER	0	0	(77)	(257)	(348)	(434)
COUNTY-OTHER	28	25	26	20	14	9
MANUFACTURING	0	0	(21)	(69)	(97)	(124)
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	66	66	66	66	66	66
MOORE COUNTY						
CANADIAN BASIN						
CACTUS	(583)	(777)	(974)	(1,170)	(1,347)	(1,530)
DUMAS	(290)	(1,021)	(1,785)	(2,679)	(3,550)	(4,437)
FRITCH	3	2	2	2	2	1
SUNRAY	105	(232)	(501)	(633)	(752)	(847)
COUNTY-OTHER	35	16	2	(13)	(21)	(30)
MANUFACTURING	(1,877)	(2,346)	(2,754)	(4,445)	(6,147)	(7,746)
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	7	7	7	7	(3,882)	(6,171)
OCHILTREE COUNTY						
CANADIAN BASIN						
BOOKER	0	0	(2)	(7)	(11)	(17)
PERRYTON	(478)	(963)	(1,438)	(1,877)	(2,341)	(2,786)
COUNTY-OTHER	24	25	26	28	30	32
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
OLDHAM COUNTY						
CANADIAN BASIN						
VEGA	18	5	9	11	11	11
COUNTY-OTHER	299	282	286	286	287	287
MINING	0	0	0	0	0	0

Water User Group (WUG) Needs/Surplus

REGION A	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
OLDHAM COUNTY						
CANADIAN BASIN						
LIVESTOCK	503	501	499	497	495	492
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	8	8	7	6	5	5
IRRIGATION	0	0	0	0	0	0
POTTER COUNTY						
CANADIAN BASIN						
AMARILLO	(1,501)	(4,129)	(7,241)	(10,389)	(13,215)	(16,315)
COUNTY-OTHER	(271)	(446)	(642)	(847)	(1,084)	(1,336)
MANUFACTURING	(314)	(542)	(786)	(1,007)	(1,220)	(1,445)
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	164	163	161	160	158	155
IRRIGATION	181	37	0	0	0	7
RED BASIN						
AMARILLO	(987)	(2,719)	(4,767)	(6,840)	(8,703)	(10,742)
COUNTY-OTHER	(412)	(510)	(620)	(736)	(869)	(1,212)
MANUFACTURING	(1,785)	(3,069)	(4,453)	(5,707)	(6,910)	(8,188)
MINING	0	0	0	0	0	0
LIVESTOCK	30	30	30	29	29	29
IRRIGATION	0	0	1	121	323	519
RANDALL COUNTY						
RED BASIN						
AMARILLO	(2,020)	(5,593)	(9,807)	(14,105)	(17,944)	(22,125)
CANYON	(1,009)	(1,589)	(2,176)	(2,770)	(3,779)	(4,313)
HAPPY	4	5	5	5	3	1
LAKE TANGLEWOOD	(172)	(200)	(225)	(248)	(266)	(284)
COUNTY-OTHER	(637)	(978)	(1,339)	(1,731)	(2,172)	(2,638)
MANUFACTURING	(41)	(169)	(295)	(401)	(508)	(619)
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	762	814	868	927	994	1,063
ROBERTS COUNTY						
CANADIAN BASIN						
MIAMI	317	316	318	237	171	104
COUNTY-OTHER	12	10	12	12	12	12
MINING	0	0	0	0	0	0
LIVESTOCK	103	103	102	101	100	99
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	4	4	4	4	4	4
MINING	0	0	0	0	0	0
LIVESTOCK	15	15	15	15	15	15
IRRIGATION	0	0	0	0	0	0

Water User Group (WUG) Needs/Surplus

REGION A	WUG (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
SHERMAN COUNTY						
CANADIAN BASIN						
STRATFORD	781	753	741	583	384	187
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	32	32	32	32	32	32
WHEELER COUNTY						
RED BASIN						
SHAMROCK	607	559	515	451	382	312
WHEELER	(184)	(249)	(308)	(365)	(412)	(453)
COUNTY-OTHER	95	94	92	83	72	60
MINING	0	0	0	0	0	0
LIVESTOCK	118	15	13	11	8	6
IRRIGATION	895	896	897	899	901	903

Water User Group (WUG) Category Summary

REGION A	2020	2030	2040	2050	2060	2070
MUNICIPAL						
POPULATION	345,540	381,158	417,140	453,985	492,307	532,142
DEMANDS (acre-feet per year)	79,557	85,913	92,583	100,001	108,191	116,808
EXISTING SUPPLIES (acre-feet per year)	73,395	65,613	58,431	52,158	46,596	41,222
NEEDS (acre-feet per year)*	(8,754)	(22,205)	(35,919)	(49,297)	(62,701)	(76,343)
COUNTY-OTHER						
POPULATION	73,086	79,850	86,406	93,075	99,959	107,078
DEMANDS (acre-feet per year)	12,080	12,879	13,702	14,643	15,675	16,764
EXISTING SUPPLIES (acre-feet per year)	11,803	11,911	12,030	12,203	12,349	12,287
NEEDS (acre-feet per year)*	(1,320)	(1,937)	(2,602)	(3,327)	(4,146)	(5,216)
MANUFACTURING						
DEMANDS (acre-feet per year)	49,695	52,589	55,369	57,763	61,343	65,194
EXISTING SUPPLIES (acre-feet per year)	46,678	46,378	46,046	44,146	43,497	43,063
NEEDS (acre-feet per year)*	(4,017)	(6,986)	(10,048)	(14,243)	(18,369)	(22,538)
MINING						
DEMANDS (acre-feet per year)	11,330	9,909	7,223	4,465	2,996	2,968
EXISTING SUPPLIES (acre-feet per year)	11,330	9,909	7,223	4,465	2,996	2,968
NEEDS (acre-feet per year)*	0	0	0	0	0	0
STEAM ELECTRIC POWER						
DEMANDS (acre-feet per year)	26,996	28,916	30,707	32,963	37,202	40,989
EXISTING SUPPLIES (acre-feet per year)	26,996	28,916	30,707	32,963	37,202	40,989
NEEDS (acre-feet per year)*	0	0	0	0	0	0
LIVESTOCK						
DEMANDS (acre-feet per year)	40,532	41,425	43,009	44,718	46,567	48,564
EXISTING SUPPLIES (acre-feet per year)	42,326	43,080	44,621	46,293	48,091	50,033
NEEDS (acre-feet per year)*	0	0	0	0	0	0
IRRIGATION						
DEMANDS (acre-feet per year)	1,513,469	1,426,414	1,312,384	1,166,561	1,020,743	874,922
EXISTING SUPPLIES (acre-feet per year)	1,360,086	1,244,605	1,122,766	989,854	859,324	730,397
NEEDS (acre-feet per year)*	(156,704)	(185,043)	(192,876)	(180,151)	(165,133)	(148,519)
REGION TOTALS						
POPULATION	418,626	461,008	503,546	547,060	592,266	639,220
DEMANDS (acre-feet per year)	1,733,659	1,658,045	1,554,977	1,421,114	1,292,717	1,166,209
EXISTING SUPPLIES (acre-feet per year)	1,572,614	1,450,412	1,321,824	1,182,082	1,050,055	920,959
NEEDS (acre-feet per year)*	(170,795)	(216,171)	(241,445)	(247,018)	(250,349)	(252,616)

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The needs shown in the WUG Category Summary report are calculated by first deducting the WUG split's projected demand from its total existing water supply volume. If the WUG split has a greater existing supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with needs in the decade are included with the Needs totals.

Water User Group (WUG) Second-Tier Identified Water Need

REGION A	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
ARMSTRONG COUNTY						
RED BASIN						
CLAUDE	0	0	0	7	44	82
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
CARSON COUNTY						
CANADIAN BASIN						
WHITE DEER	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
GROOM	0	0	0	0	0	0
PANHANDLE	42	473	534	529	528	528
WHITE DEER	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
CHILDRESS COUNTY						
RED BASIN						
CHILDRESS	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
COLLINGSWORTH COUNTY						
RED BASIN						
WELLINGTON	481	495	503	520	533	545
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
DALLAM COUNTY						
CANADIAN BASIN						
DALHART	455	734	1,049	1,381	1,714	2,048
TEXLINE	0	0	0	22	73	133
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	45,181	30,501	0	0	0	0
DONLEY COUNTY						
RED BASIN						
CLARENDON	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION A	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
GRAY COUNTY						
CANADIAN BASIN						
PAMPA	0	1,591	2,313	1,988	2,765	3,566
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
MCLEAN	0	0	0	66	110	155
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
HALL COUNTY						
RED BASIN						
MEMPHIS	0	0	0	54	86	119
COUNTY-OTHER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
HANSFORD COUNTY						
CANADIAN BASIN						
GRUVER	0	0	85	168	242	313
SPEARMAN	0	0	0	258	440	607
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
HARTLEY COUNTY						
CANADIAN BASIN						
DALHART	215	318	416	501	578	646
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	48,108	41,207	8,174	0	0	0
HEMPHILL COUNTY						
CANADIAN BASIN						
CANADIAN	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION A	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
HEMPHILL COUNTY						
RED BASIN						
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
HUTCHINSON COUNTY						
CANADIAN BASIN						
BORGER	0	424	846	1,237	1,541	1,821
FRITCH	0	0	0	0	0	0
STINNETT	0	0	0	78	128	179
TCW SUPPLY INC	17	192	316	407	476	510
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	860	1,739	2,614	3,487	4,416
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
LIPSCOMB COUNTY						
CANADIAN BASIN						
BOOKER	0	0	59	239	329	414
COUNTY-OTHER	0	0	0	0	0	0
MANUFACTURING	0	0	21	69	97	124
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
MOORE COUNTY						
CANADIAN BASIN						
CACTUS	551	741	933	1,125	1,297	1,475
DUMAS	157	869	1,614	2,489	3,340	4,206
FRITCH	0	0	0	0	0	0
SUNRAY	0	190	455	581	695	784
COUNTY-OTHER	0	0	0	0	0	7
MANUFACTURING	1,877	2,346	2,754	4,445	6,147	7,746
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
OCHILTREE COUNTY						
CANADIAN BASIN						
BOOKER	0	0	2	6	10	16
PERRYTON	393	873	1,342	1,774	2,230	2,667
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
OLDHAM COUNTY						
CANADIAN BASIN						
VEGA	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION A	**WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)**					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**
OLDHAM COUNTY						
RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
POTTER COUNTY						
CANADIAN BASIN						
AMARILLO	924	3,487	6,537	9,621	12,375	15,399
COUNTY-OTHER	101	260	439	625	842	1,071
MANUFACTURING	314	542	786	1,007	1,220	1,445
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
AMARILLO	607	2,296	4,303	6,334	8,150	10,139
COUNTY-OTHER	316	405	505	611	732	1,064
MANUFACTURING	1,785	3,069	4,453	5,707	6,910	8,188
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RANDALL COUNTY						
RED BASIN						
AMARILLO	1,243	4,723	8,853	13,063	16,803	20,882
CANYON	882	1,447	2,020	2,599	3,592	4,110
HAPPY	0	0	0	0	0	0
LAKE TANGLEWOOD	147	176	201	224	242	260
COUNTY-OTHER	494	820	1,166	1,542	1,965	2,413
MANUFACTURING	41	169	295	401	508	619
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
ROBERTS COUNTY						
CANADIAN BASIN						
MIAMI	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
RED BASIN						
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0
SHERMAN COUNTY						
CANADIAN BASIN						
STRATFORD	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0

Water User Group (WUG) Second-Tier Identified Water Need

REGION A	WUG SECOND-TIER NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
SHERMAN COUNTY						
CANADIAN BASIN						
IRRIGATION	0	0	0	0	0	0
WHEELER COUNTY						
RED BASIN						
SHAMROCK	0	0	0	0	0	0
WHEELER	169	234	292	349	395	435
COUNTY-OTHER	0	0	0	0	0	0
MINING	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	0	0	0	0	0	0

***Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.**

Water User Group (WUG) Second-Tier Identified Water Need Summary

REGION A

	2020	2030	2040	2050	2060	2070
MUNICIPAL	6,283	19,263	32,673	45,620	58,716	72,039
COUNTY-OTHER	911	1,485	2,110	2,778	3,539	4,555
MANUFACTURING	4,017	6,986	10,048	14,243	18,369	22,538
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	93,289	71,708	8,174	0	0	0

*Second-tier needs are WUG split needs adjusted to include the implementation of recommended demand reduction and direct reuse water management strategies.

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Primary Region: A

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
AMARILLO	A	CONJUNCTIVE USE - CRMWA	A | MEREDITH LAKE/RESERVOIR	4,579	4,595	4,381	4,117	4,114	4,111	$451	$106
AMARILLO	A	DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | CARSON COUNTY	0	0	11,200	5,509	6,025	4,924	N/A	$161
AMARILLO	A	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | POTTER COUNTY	3,210	1,475	1,087	2,500	1,000	0	$941	N/A
AMARILLO	A	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	0	0	0	0	11,200	N/A	$1538
AMARILLO	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	22,056	21,027	19,760	19,745	19,731	N/A	$240
AMARILLO	A	MUNICIPAL CONSERVATION - AMARILLO	DEMAND REDUCTION	1,734	1,935	2,122	2,316	2,534	2,762	$250	$251
AMARILLO	A	REPLACE WELL CAPACITY FOR CRMWA I	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	4,135	3,695	7,822	9,461	11,510	N/A	$179
BOOKER	A	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	0	0	529	481	453	576	N/A	$83
BOOKER	A	MUNICIPAL CONSERVATION - BOOKER	DEMAND REDUCTION	15	17	18	19	20	21	$648	$559
BORGER	A	CONJUNCTIVE USE - CRMWA	A | MEREDITH LAKE/RESERVOIR	702	652	620	582	581	581	$451	$106
BORGER	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	6,000	5,140	4,261	3,386	2,513	1,584	$521	$158
BORGER	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	3,128	2,974	2,793	2,790	2,787	N/A	$240
BORGER	A	MUNICIPAL CONSERVATION - BORGER	DEMAND REDUCTION	104	107	106	106	106	106	$410	$418
BORGER	A	REPLACE WELL CAPACITY FOR CRMWA I	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	586	805	1,106	1,337	1,626	N/A	$179
CACTUS	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	A | OGALLALA AQUIFER | MOORE COUNTY	3,565	3,078	2,653	2,286	1,933	1,565	$422	$145
CACTUS	A	MUNICIPAL CONSERVATION - CACTUS	DEMAND REDUCTION	32	36	41	45	50	55	$519	$460
CANADIAN	A	MUNICIPAL CONSERVATION - CANADIAN	DEMAND REDUCTION	25	27	29	32	34	36	$536	$481
CANADIAN	A	WATER AUDITS AND LEAK REPAIR - CANADIAN	DEMAND REDUCTION	39	43	47	50	54	57	$767	$796
CANADIAN RIVER MUNICIPAL WATER AUTHORITY - UNASSIGNED WATER VOLUMES	A	CONJUNCTIVE USE - CRMWA	A | OGALLALA AQUIFER ASR	2,000	2,000	2,000	2,000	2,000	2,000	$1124	$240
CANADIAN RIVER MUNICIPAL WATER AUTHORITY - UNASSIGNED WATER VOLUMES	A	CONJUNCTIVE USE - CRMWA	A | OGALLALA AQUIFER ASR | HUTCHINSON COUNTY	2,000	2,000	2,000	2,000	2,000	2,000	$1124	$240
CANADIAN RIVER MUNICIPAL WATER AUTHORITY - UNASSIGNED WATER VOLUMES	A	CONJUNCTIVE USE - CRMWA	O | OGALLALA AQUIFER ASR | LUBBOCK COUNTY	2,400	2,400	2,400	2,400	2,400	2,400	$1124	$240
CANYON	A	DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	A | DOCKUM AQUIFER | RANDALL COUNTY	932	943	953	963	972	981	$425	$189
CANYON	A	DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	A | OGALLALA AQUIFER | RANDALL COUNTY	468	1,157	1,847	1,837	2,828	3,319	$425	$189

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
CANYON	A	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | POTTER COUNTY	94	239	384	507	0	0	$941	N/A
CANYON	A	MUNICIPAL CONSERVATION - CANYON	DEMAND REDUCTION	127	142	156	171	187	203	$604	$583
CHILDRESS	A	MUNICIPAL CONSERVATION - CHILDRESS	DEMAND REDUCTION	51	52	54	55	57	57	$437	$438
CHILDRESS	A	WATER AUDITS AND LEAK REPAIR - CHILDRESS	DEMAND REDUCTION	81	83	84	86	88	91	$776	$807
CLARENDON	A	MUNICIPAL CONSERVATION - CLARENDON	DEMAND REDUCTION	14	13	13	13	13	13	$787	$813
CLAUDE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - CLAUDE	A | OGALLALA AQUIFER | ARMSTRONG COUNTY	0	0	400	400	400	400	N/A	$185
CLAUDE	A	MUNICIPAL CONSERVATION - CLAUDE	DEMAND REDUCTION	11	11	10	10	10	10	$746	$814
CLAUDE	A	WATER AUDITS AND LEAK REPAIR - CLAUDE	DEMAND REDUCTION	18	18	18	18	18	18	$651	$676
COUNTY-OTHER, HALL	A	ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)	A | SEYMOUR AQUIFER | HALL COUNTY	75	75	75	75	75	75	$3345	$1558
COUNTY-OTHER, HALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - HALL COUNTY OTHER (TURKEY)	O | OGALLALA AQUIFER | BRISCOE COUNTY	100	100	100	100	100	100	$1380	$250
COUNTY-OTHER, HALL	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - HALL COUNTY OTHER (BRICE-LESLY)	A | SEYMOUR AQUIFER | HALL COUNTY	50	50	50	50	50	50	$688	$188
COUNTY-OTHER, HALL	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - HALL COUNTY OTHER (ESTELLINE)	A | SEYMOUR AQUIFER | HALL COUNTY	50	50	50	50	50	50	$360	$120
COUNTY-OTHER, HALL	A	MUNICIPAL CONSERVATION - HALL COUNTY OTHER	DEMAND REDUCTION	9	10	10	10	10	10	$841	$842
COUNTY-OTHER, HALL	A	WATER AUDITS AND LEAK REPAIR - HALL COUNTY OTHER	DEMAND REDUCTION	16	16	16	16	16	16	$674	$693
COUNTY-OTHER, MOORE	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	A | OGALLALA AQUIFER | MOORE COUNTY	58	76	93	112	128	145	$422	$125
COUNTY-OTHER, MOORE	A	MUNICIPAL CONSERVATION - MOORE COUNTY OTHER	DEMAND REDUCTION	14	15	17	19	21	23	$857	$723
COUNTY-OTHER, POTTER	A	DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER	A | DOCKUM AQUIFER | POTTER COUNTY	700	700	700	700	700	700	$527	$127
COUNTY-OTHER, POTTER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	A | OGALLALA AQUIFER | POTTER COUNTY	900	900	900	900	900	856	$488	$118
COUNTY-OTHER, POTTER	A	DEVELOP OGALLALA AQUIFER SUPPLIES (IRRIGATION CONSERVATION) - POTTER COUNTY OTHER	A | OGALLALA AQUIFER | POTTER COUNTY	0	0	0	0	0	44	N/A	$118
COUNTY-OTHER, POTTER	A	MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	DEMAND REDUCTION	112	123	135	148	161	176	$468	$461
COUNTY-OTHER, POTTER	A	WATER AUDITS AND LEAK REPAIR - POTTER COUNTY OTHER	DEMAND REDUCTION	154	168	183	199	218	237	$1119	$1170
COUNTY-OTHER, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY OTHER	A | OGALLALA AQUIFER | RANDALL COUNTY	500	1,000	1,200	2,600	2,600	2,800	$248	$90
COUNTY-OTHER, RANDALL	A	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | POTTER COUNTY	2	6	10	13	15	17	$941	$196
COUNTY-OTHER, RANDALL	A	MUNICIPAL CONSERVATION - RANDALL COUNTY OTHER	DEMAND REDUCTION	143	158	173	189	207	225	$493	$492
DALHART	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	2,700	2,700	2,700	2,700	2,700	2,700	$213	$83
DALHART	A	MUNICIPAL CONSERVATION - DALHART	DEMAND REDUCTION	79	86	93	100	107	113	$369	$357
DUMAS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	A | OGALLALA-RITA BLANCA AQUIFER | HARTLEY COUNTY	2,000	2,000	2,000	4,500	4,500	4,500	$332	$98

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
DUMAS	A	MUNICIPAL CONSERVATION - DUMAS	DEMAND REDUCTION	133	152	171	190	210	231	$606	$558
FRITCH	A	MUNICIPAL CONSERVATION - FRITCH	DEMAND REDUCTION	15	16	15	15	15	15	$729	$740
FRITCH	A	WATER AUDITS AND LEAK REPAIR - FRITCH	DEMAND REDUCTION	22	22	22	22	22	22	$1000	$1054
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY - UNASSIGNED WATER VOLUMES	A	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	A | OGALLALA AQUIFER | DONLEY COUNTY	1,817	1,818	1,828	1,848	1,875	1,888	$629	$101
GROOM	A	MUNICIPAL CONSERVATION - GROOM	DEMAND REDUCTION	5	5	5	5	5	5	$1252	$1281
GRUVER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	A | OGALLALA AQUIFER | HANSFORD COUNTY	0	0	350	350	350	350	N/A	$118
GRUVER	A	MUNICIPAL CONSERVATION - GRUVER	DEMAND REDUCTION	10	11	11	13	14	14	$894	$713
GRUVER	A	WATER AUDITS AND LEAK REPAIR - GRUVER	DEMAND REDUCTION	13	14	15	15	16	17	$1036	$1084
IRRIGATION, ARMSTRONG	A	IRRIGATION CONSERVATION - ARMSTRONG COUNTY	DEMAND REDUCTION	206	425	721	800	869	900	$17	$17
IRRIGATION, ARMSTRONG	A	WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)		402	402	402	402	402	402	$8	$8
IRRIGATION, CARSON	A	IRRIGATION CONSERVATION - CARSON COUNTY	DEMAND REDUCTION	3,980	6,910	12,747	14,010	14,774	15,146	$17	$17
IRRIGATION, CARSON	A	WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)		4,850	4,850	4,850	4,850	4,850	4,850	$8	$8
IRRIGATION, CHILDRESS	A	IRRIGATION CONSERVATION - CHILDRESS COUNTY	DEMAND REDUCTION	351	632	1,100	1,220	1,324	1,378	$17	$17
IRRIGATION, COLLINGSWORTH	A	IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	DEMAND REDUCTION	548	1,037	1,647	1,843	2,104	2,250	$17	$17
IRRIGATION, DALLAM	A	IRRIGATION CONSERVATION - DALLAM COUNTY	DEMAND REDUCTION	34,218	61,174	106,343	121,011	132,167	140,612	$17	$17
IRRIGATION, DONLEY	A	IRRIGATION CONSERVATION - DONLEY COUNTY	DEMAND REDUCTION	836	1,484	2,436	2,729	3,065	3,259	$17	$17
IRRIGATION, DONLEY	A	WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)		1,866	1,866	1,866	1,866	1,866	1,866	$8	$8
IRRIGATION, GRAY	A	IRRIGATION CONSERVATION - GRAY COUNTY	DEMAND REDUCTION	1,361	2,301	4,216	4,648	4,929	5,078	$17	$17
IRRIGATION, GRAY	A	WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)		1,858	1,858	1,858	1,858	1,858	1,858	$8	$8
IRRIGATION, HALL	A	IRRIGATION CONSERVATION - HALL COUNTY	DEMAND REDUCTION	392	679	1,145	1,280	1,419	1,499	$17	$17
IRRIGATION, HANSFORD	A	IRRIGATION CONSERVATION - HANSFORD COUNTY	DEMAND REDUCTION	9,447	17,175	31,242	34,401	36,373	37,260	$17	$17
IRRIGATION, HARTLEY	A	IRRIGATION CONSERVATION - HARTLEY COUNTY	DEMAND REDUCTION	29,197	52,161	90,476	103,095	113,047	120,509	$17	$17
IRRIGATION, HEMPHILL	A	IRRIGATION CONSERVATION - HEMPHILL COUNTY	DEMAND REDUCTION	57	111	174	196	224	239	$17	$17
IRRIGATION, HUTCHINSON	A	IRRIGATION CONSERVATION - HUTCHINSON COUNTY	DEMAND REDUCTION	2,692	4,694	8,578	9,459	10,010	10,281	$17	$17
IRRIGATION, HUTCHINSON	A	WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)		2,960	2,960	2,960	2,960	2,960	2,960	$8	$8
IRRIGATION, LIPSCOMB	A	IRRIGATION CONSERVATION - LIPSCOMB COUNTY	DEMAND REDUCTION	936	1,702	2,945	3,268	3,555	3,706	$17	$17
IRRIGATION, MOORE	A	IRRIGATION CONSERVATION - MOORE COUNTY	DEMAND REDUCTION	13,308	24,120	41,895	47,571	52,037	55,406	$17	$17
IRRIGATION, OCHILTREE	A	IRRIGATION CONSERVATION - OCHILTREE COUNTY	DEMAND REDUCTION	4,030	7,195	13,177	14,476	15,292	15,670	$17	$17
IRRIGATION, OCHILTREE	A	IRRIGATION CONSERVATION - OLDHAM COUNTY	DEMAND REDUCTION	127	360	567	617	694	723	$17	$17

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
IRRIGATION, POTTER	A	IRRIGATION CONSERVATION - POTTER COUNTY	DEMAND REDUCTION	95	209	319	359	413	441	$17	$17
IRRIGATION, POTTER	A	WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)		216	216	216	216	216	216	$8	$8
IRRIGATION, RANDALL	A	IRRIGATION CONSERVATION - RANDALL COUNTY	DEMAND REDUCTION	647	1,641	2,637	2,890	3,221	3,356	$17	$17
IRRIGATION, ROBERTS	A	IRRIGATION CONSERVATION - ROBERTS COUNTY	DEMAND REDUCTION	435	717	1,339	1,475	1,550	1,590	$17	$17
IRRIGATION, ROBERTS	A	WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)		469	469	469	469	469	469	$8	$8
IRRIGATION, SHERMAN	A	IRRIGATION CONSERVATION - SHERMAN COUNTY	DEMAND REDUCTION	20,156	36,498	63,651	72,285	78,846	83,721	$17	$17
IRRIGATION, WHEELER	A	IRRIGATION CONSERVATION - WHEELER COUNTY	DEMAND REDUCTION	395	706	1,230	1,364	1,480	1,542	$17	$17
IRRIGATION, WHEELER	A	WEATHER MODIFICATION (PRECIPITATION ENHANCEMENT)		944	944	944	944	944	944	$8	$8
LAKE TANGLEWOOD	A	DEVELOP OGALLALA AQUIFER SUPPLIES - LAKE TANGLEWOOD	A | OGALLALA AQUIFER | RANDALL COUNTY	300	300	300	300	300	300	$1035	$205
LAKE TANGLEWOOD	A	MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	DEMAND REDUCTION	9	8	8	8	8	8	$832	$897
LAKE TANGLEWOOD	A	WATER AUDITS AND LEAK REPAIR - LAKE TANGLEWOOD	DEMAND REDUCTION	16	16	16	16	16	16	$514	$529
MANUFACTURING, HUTCHINSON	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	0	860	1,739	2,614	3,487	4,416	N/A	$158
MANUFACTURING, LIPSCOMB	A	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	A | OGALLALA AQUIFER | LIPSCOMB COUNTY	0	0	21	69	97	124	N/A	$83
MANUFACTURING, MOORE	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	A | OGALLALA AQUIFER | MOORE COUNTY	1,877	2,346	2,754	3,102	3,439	3,790	$422	$125
MANUFACTURING, MOORE	A	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - MANUFACTURING MOORE COUNTY	A | OGALLALA AQUIFER | MOORE COUNTY	0	0	0	4,000	4,000	4,000	N/A	$97
MANUFACTURING, POTTER	A	DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | CARSON COUNTY	0	0	0	5,691	5,175	6,277	N/A	$161
MANUFACTURING, POTTER	A	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | POTTER COUNTY	2,642	3,749	3,508	1,501	3,061	3,583	$941	$196
MANUFACTURING, POTTER	A	REPLACE WELL CAPACITY FOR CRMWA I	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	0	2,000	0	0	0	N/A	N/A
MANUFACTURING, RANDALL	A	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING	A | OGALLALA AQUIFER | RANDALL COUNTY	0	300	300	300	300	300	N/A	$94
MANUFACTURING, RANDALL	A	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	A | OGALLALA AQUIFER | POTTER COUNTY	52	131	211	279	324	367	$941	$196
MCLEAN	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	A | OGALLALA AQUIFER | GRAY COUNTY	200	200	200	200	200	200	$446	$116
MCLEAN	A	MUNICIPAL CONSERVATION - MCLEAN	DEMAND REDUCTION	7	7	8	9	10	11	$1075	$812
MCLEAN	A	WATER AUDITS AND LEAK REPAIR - MCLEAN	DEMAND REDUCTION	10	11	12	14	15	16	$823	$863
MEMPHIS	A	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	A | OGALLALA AQUIFER | DONLEY COUNTY	0	0	0	150	150	150	N/A	$188
MEMPHIS	A	MUNICIPAL CONSERVATION - MEMPHIS	DEMAND REDUCTION	15	15	14	14	14	14	$781	$806
MEMPHIS	A	WATER AUDITS AND LEAK REPAIR - MEMPHIS	DEMAND REDUCTION	19	8	0	0	0	0	$1210	N/A
MIAMI	A	MUNICIPAL CONSERVATION - MIAMI	DEMAND REDUCTION	6	7	6	6	6	6	$1034	$1056

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
MIAMI	A	WATER AUDITS AND LEAK REPAIR - MIAMI	DEMAND REDUCTION	11	11	11	11	11	11	$547	$562
PAMPA	A	CONJUNCTIVE USE - CRMWA	A | MEREDITH LAKE/RESERVOIR	181	168	161	385	385	385	$451	$106
PAMPA	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	A | OGALLALA AQUIFER | GRAY COUNTY	2,000	2,000	2,000	2,000	2,000	2,000	$490	$130
PAMPA	A	EXPAND CAPACITY CRMWA II	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	806	772	1,850	1,848	1,847	N/A	$240
PAMPA	A	MUNICIPAL CONSERVATION - PAMPA	DEMAND REDUCTION	146	161	178	202	220	240	$584	$559
PAMPA	A	REPLACE WELL CAPACITY FOR CRMWA I	A | OGALLALA AQUIFER | ROBERTS COUNTY	0	151	209	732	886	1,077	N/A	$179
PANHANDLE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	A | OGALLALA AQUIFER | CARSON COUNTY	600	600	600	600	600	600	$621	$173
PANHANDLE	A	MUNICIPAL CONSERVATION - PANHANDLE	DEMAND REDUCTION	18	19	19	19	19	19	$647	$644
PANHANDLE	A	WATER AUDITS AND LEAK REPAIR - PANHANDLE	DEMAND REDUCTION	29	29	29	29	29	29	$871	$914
PERRYTON	A	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	A | OGALLALA AQUIFER | OCHILTREE COUNTY	1,400	1,400	1,400	2,800	2,800	2,800	$425	$109
PERRYTON	A	MUNICIPAL CONSERVATION - PERRYTON	DEMAND REDUCTION	85	90	96	103	111	119	$374	$364
SHAMROCK	A	MUNICIPAL CONSERVATION - SHAMROCK	DEMAND REDUCTION	12	13	13	14	14	15	$851	$780
SHAMROCK	A	WATER AUDITS AND LEAK REPAIR - SHAMROCK	DEMAND REDUCTION	18	18	18	18	19	20	$1127	$1195
SPEARMAN	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	A | OGALLALA AQUIFER | HANSFORD COUNTY	0	0	0	650	650	650	N/A	$164
SPEARMAN	A	MUNICIPAL CONSERVATION - SPEARMAN	DEMAND REDUCTION	24	24	25	25	26	27	$619	$606
STINNETT	A	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	0	0	0	225	225	225	N/A	$139
STINNETT	A	MUNICIPAL CONSERVATION - STINNETT	DEMAND REDUCTION	15	15	15	15	15	15	$695	$699
STINNETT	A	WATER AUDITS AND LEAK REPAIR - STINNETT	DEMAND REDUCTION	22	23	22	22	22	22	$874	$914
STRATFORD	A	MUNICIPAL CONSERVATION - STRATFORD	DEMAND REDUCTION	15	17	17	18	18	19	$721	$650
STRATFORD	A	WATER AUDITS AND LEAK REPAIR - STRATFORD	DEMAND REDUCTION	24	25	26	26	27	27	$932	$979
SUNRAY	A	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	A | OGALLALA AQUIFER | MOORE COUNTY	0	850	850	850	850	850	N/A	$126
SUNRAY	A	MUNICIPAL CONSERVATION - SUNRAY	DEMAND REDUCTION	16	19	20	24	26	28	$689	$564
SUNRAY	A	WATER AUDITS AND LEAK REPAIR - SUNRAY	DEMAND REDUCTION	21	23	26	28	31	35	$1078	$1128
TCW SUPPLY INC	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	A | OGALLALA AQUIFER | HUTCHINSON COUNTY	575	575	575	575	575	575	$736	$169
TCW SUPPLY INC	A	MUNICIPAL CONSERVATION - TCW SUPPLY	DEMAND REDUCTION	21	21	21	21	22	22	$522	$510
TCW SUPPLY INC	A	WATER AUDITS AND LEAK REPAIR - TCW SUPPLY	DEMAND REDUCTION	37	38	38	38	37	37	$587	$605
TEXLINE	A	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	A | OGALLALA-RITA BLANCA AQUIFER | DALLAM COUNTY	0	0	0	150	150	150	N/A	$192
TEXLINE	A	MUNICIPAL CONSERVATION - TEXLINE	DEMAND REDUCTION	7	7	8	9	9	10	$1002	$753
TEXLINE	A	WATER AUDITS AND LEAK REPAIR - TEXLINE	DEMAND REDUCTION	11	13	14	15	17	18	$516	$530

Recommended Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
VEGA	A	MUNICIPAL CONSERVATION - VEGA	DEMAND REDUCTION	8	9	9	9	9	9	$975	$918
VEGA	A	WATER AUDITS AND LEAK REPAIR - VEGA	DEMAND REDUCTION	14	14	14	14	14	14	$707	$734
WELLINGTON	A	ADVANCED TREATMENT - WELLINGTON	A | SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	500	500	500	500	500	500	$1029	$413
WELLINGTON	A	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	A | SEYMOUR AQUIFER | COLLINGSWORTH COUNTY	180	180	180	180	180	180	$1485	$279
WELLINGTON	A	MUNICIPAL CONSERVATION - WELLINGTON	DEMAND REDUCTION	18	18	19	19	20	20	$650	$639
WELLINGTON	A	WATER AUDITS AND LEAK REPAIR - WELLINGTON	DEMAND REDUCTION	26	27	27	28	29	30	$883	$925
WHEELER	A	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	A | OGALLALA AQUIFER | WHEELER COUNTY	500	500	500	500	500	500	$625	$157
WHEELER	A	MUNICIPAL CONSERVATION - WHEELER	DEMAND REDUCTION	15	15	16	16	17	18	$638	$593
WHITE DEER	A	MUNICIPAL CONSERVATION - WHITE DEER	DEMAND REDUCTION	8	9	9	9	9	9	$968	$944
WHITE DEER	A	WATER AUDITS AND LEAK REPAIR - WHITE DEER	DEMAND REDUCTION	12	12	12	12	12	12	$922	$962
Region A Total RecommendedWMS Supplies				186,579	318,193	498,532	561,885	603,280	644,976		

Recommended Projects Associated with Water Management Strategies

Project Sponosr Region: A

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
AMARILLO	Y	DEVELOP CARSON COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$37,528,000	2040
AMARILLO	Y	DEVELOP POTTER COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$53,397,000	2020
AMARILLO	Y	DEVELOP ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$170,217,000	2070
BOOKER	N	DEVELOP OGALALLA AQUIFER SUPPLIES - BOOKER	MULTIPLE WELLS/WELL FIELD	$1,489,400	2040
BORGER	Y	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - BORGER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$26,070,400	2020
CACTUS	Y	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - CACTUS	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$18,191,900	2020
CANADIAN	N	MUNICIPAL CONSERVATION - CANADIAN	WATER LOSS CONTROL	$2,294,900	2020
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	Y	ASR - CRMWA	CONVEYANCE/TRANSMISSION PIPELINE; INJECTION WELL; PUMP STATION	$67,649,300	2030
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	Y	EXPANSION OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2024 - CRMWA2	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$250,299,000	2024
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	Y	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2030 - CRMWA	MULTIPLE WELLS/WELL FIELD	$8,267,250	2030
CANADIAN RIVER MUNICIPAL WATER AUTHORITY	Y	REPLACE CAPACITY OF ROBERTS COUNTY WELL FIELD (OGALLALA AQUIFER) IN 2040 - CRMWA	MULTIPLE WELLS/WELL FIELD	$16,533,500	2040
CANYON	N	DEVELOP DOCKUM/OGALLALA AQUIFER SUPPLIES - CANYON	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$11,614,100	2020
CHILDRESS	N	MUNICIPAL CONSERVATION - CHILDRESS	WATER LOSS CONTROL	$4,098,000	2020
CLAUDE	N	DEVELOP OGALLALA AQUIFER SUPPLIES - CLAUDE	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$2,891,100	2040
CLAUDE	N	MUNICIPAL CONSERVATION - CLAUDE	WATER LOSS CONTROL	$721,800	2020
COUNTY-OTHER, HALL	N	ADVANCED TREATMENT - HALL COUNTY OTHER (LAKEVIEW)	NEW WATER TREATMENT PLANT	$1,600,800	2020
COUNTY-OTHER, HALL	N	MUNICIPAL CONSERVATION - HALL COUNTY OTHER	WATER LOSS CONTROL	$660,000	2020
COUNTY-OTHER, HALL	N	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (BRICE-LESLY)	SINGLE WELL	$299,300	2020
COUNTY-OTHER, HALL	N	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (ESTELLINE)	SINGLE WELL	$141,100	2020
COUNTY-OTHER, HALL	N	NEW GROUNDWATER SOURCE - HALL COUNTY OTHER (TURKEY)	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$1,345,300	2020
COUNTY-OTHER, POTTER	N	DEVELOP DOCKUM AQUIFER SUPPLIES - POTTER COUNTY OTHER	MULTIPLE WELLS/WELL FIELD	$3,345,600	2020
COUNTY-OTHER, POTTER	N	DEVELOP OGALLALA AQUIFER SUPPLIES - POTTER COUNTY OTHER	MULTIPLE WELLS/WELL FIELD	$3,979,400	2030
COUNTY-OTHER, POTTER	N	MUNICIPAL CONSERVATION - POTTER COUNTY OTHER	WATER LOSS CONTROL	$13,409,600	2020
COUNTY-OTHER, RANDALL	N	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY OTHER	MULTIPLE WELLS/WELL FIELD	$5,299,300	2030
DALHART	N	DEVELOP OGALLALA AQUIFER SUPPLIES - DALHART	MULTIPLE WELLS/WELL FIELD; SINGLE WELL	$4,197,900	2020
DUMAS	N	DEVELOP OGALLALA AQUIFER SUPPLIES - DUMAS	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$12,544,700	2020
FRITCH	N	MUNICIPAL CONSERVATION - FRITCH	WATER LOSS CONTROL	$1,367,000	2020
GREENBELT MUNICIPAL & INDUSTRIAL WATER AUTHORITY	Y	DEVELOP OGALLALA AQUIFER IN DONLEY COUNTY - GREENBELT MIWA	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$12,617,000	2020
GRUVER	N	DEVELOP OGALLALA AQUIFER SUPPLIES - GRUVER	MULTIPLE WELLS/WELL FIELD	$1,385,600	2040
GRUVER	N	MUNICIPAL CONSERVATION - GRUVER	WATER LOSS CONTROL	$964,600	2020
IRRIGATION, ARMSTRONG	N	IRRIGATION CONSERVATION - ARMSTRONG COUNTY	ON FARM IRRIGATION CONSERVATION	$154,200	2020

Recommended Projects Associated with Water Management Strategies

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
IRRIGATION, CARSON	N	IRRIGATION CONSERVATION - CARSON COUNTY	ON FARM IRRIGATION CONSERVATION	$2,047,700	2020
IRRIGATION, CHILDRESS	N	IRRIGATION CONSERVATION - CHILDRESS COUNTY	ON FARM IRRIGATION CONSERVATION	$268,700	2020
IRRIGATION, COLLINGSWORTH	N	IRRIGATION CONSERVATION - COLLINGSWORTH COUNTY	ON FARM IRRIGATION CONSERVATION	$659,600	2020
IRRIGATION, DALLAM	N	IRRIGATION CONSERVATION - DALLAM COUNTY	ON FARM IRRIGATION CONSERVATION	$13,596,900	2020
IRRIGATION, DONLEY	N	IRRIGATION CONSERVATION - DONLEY COUNTY	ON FARM IRRIGATION CONSERVATION	$885,200	2020
IRRIGATION, GRAY	N	IRRIGATION CONSERVATION - GRAY COUNTY	ON FARM IRRIGATION CONSERVATION	$782,700	2020
IRRIGATION, HALL	N	IRRIGATION CONSERVATION - HALL COUNTY	ON FARM IRRIGATION CONSERVATION	$372,500	2020
IRRIGATION, HANSFORD	N	IRRIGATION CONSERVATION - HANSFORD COUNTY	ON FARM IRRIGATION CONSERVATION	$4,959,300	2020
IRRIGATION, HARTLEY	N	IRRIGATION CONSERVATION - HARTLEY COUNTY	ON FARM IRRIGATION CONSERVATION	$12,696,300	2020
IRRIGATION, HEMPHILL	N	IRRIGATION CONSERVATION - HEMPHILL COUNTY	ON FARM IRRIGATION CONSERVATION	$70,100	2020
IRRIGATION, HUTCHINSON	N	IRRIGATION CONSERVATION - HUTCHINSON COUNTY	ON FARM IRRIGATION CONSERVATION	$1,470,800	2020
IRRIGATION, LIPSCOMB	N	IRRIGATION CONSERVATION - LIPSCOMB COUNTY	ON FARM IRRIGATION CONSERVATION	$735,600	2020
IRRIGATION, MOORE	N	IRRIGATION CONSERVATION - MOORE COUNTY	ON FARM IRRIGATION CONSERVATION	$5,258,000	2020
IRRIGATION, OCHILTREE	N	IRRIGATION CONSERVATION - OCHILTREE COUNTY	ON FARM IRRIGATION CONSERVATION	$2,104,300	2020
IRRIGATION, OLDHAM	N	IRRIGATION CONSERVATION - OLDHAM COUNTY	ON FARM IRRIGATION CONSERVATION	$144,700	2020
IRRIGATION, POTTER	N	IRRIGATION CONSERVATION - POTTER COUNTY	ON FARM IRRIGATION CONSERVATION	$126,000	2020
IRRIGATION, RANDALL	N	IRRIGATION CONSERVATION - RANDALL COUNTY	ON FARM IRRIGATION CONSERVATION	$661,700	2020
IRRIGATION, ROBERTS	N	IRRIGATION CONSERVATION - ROBERTS COUNTY	ON FARM IRRIGATION CONSERVATION	$219,000	2020
IRRIGATION, SHERMAN	N	IRRIGATION CONSERVATION - SHERMAN COUNTY	ON FARM IRRIGATION CONSERVATION	$8,123,100	2020
IRRIGATION, WHEELER	N	IRRIGATION CONSERVATION - WHEELER COUNTY	ON FARM IRRIGATION CONSERVATION	$301,500	2020
LAKE TANGLEWOOD	N	DEVELOP OGALLALA AQUIFER SUPPLIES - LAKE TANGLEWOOD	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$2,976,400	2020
LAKE TANGLEWOOD	N	MUNICIPAL CONSERVATION - LAKE TANGLEWOOD	WATER LOSS CONTROL	$492,000	2020
MANUFACTURING, MOORE	N	DEVELOP NEW WELL FIELD (OGALLALA AQUIFER) - MANUFACTURING MOORE COUNTY	MULTIPLE WELLS/WELL FIELD	$11,244,800	2050
MANUFACTURING, RANDALL	N	DEVELOP OGALLALA AQUIFER SUPPLIES - RANDALL COUNTY MANUFACTURING	MULTIPLE WELLS/WELL FIELD	$746,000	2020
MCLEAN	N	DEVELOP OGALLALA AQUIFER SUPPLIES - MCLEAN	SINGLE WELL	$789,400	2020
MCLEAN	N	MUNICIPAL CONSERVATION - MCLEAN	WATER LOSS CONTROL	$669,900	2020
MEMPHIS	N	DEVELOP OGALLALA AQUIFER SUPPLIES - MEMPHIS	MULTIPLE WELLS/WELL FIELD	$1,183,900	2050
MEMPHIS	N	MUNICIPAL CONSERVATION - MEMPHIS	WATER LOSS CONTROL	$470,000	2020
MIAMI	N	MUNICIPAL CONSERVATION - MIAMI	WATER LOSS CONTROL	$373,200	2020
PAMPA	N	DEVELOP OGALLALA AQUIFER SUPPLIES - PAMPA	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$8,618,100	2030
PANHANDLE	N	DEVELOP OGALLALA AQUIFER SUPPLIES - PANHANDLE	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$3,217,800	2020
PANHANDLE	N	MUNICIPAL CONSERVATION - PANHANDLE	WATER LOSS CONTROL	$1,559,800	2020
PERRYTON	N	DEVELOP OGALLALA AQUIFER SUPPLIES - PERRYTON	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$10,584,100	2020
SHAMROCK	N	MUNICIPAL CONSERVATION - SHAMROCK	WATER LOSS CONTROL	$1,301,900	2020
SPEARMAN	N	DEVELOP OGALLALA AQUIFER SUPPLIES - SPEARMAN	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$3,665,600	2050
STINNETT	N	DEVELOP OGALLALA AQUIFER SUPPLIES - STINNETT	SINGLE WELL	$908,000	2050

Recommended Projects Associated with Water Management Strategies

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
STINNETT	N	MUNICIPAL CONSERVATION - STINNETT	WATER LOSS CONTROL	$1,212,200	2020
STRATFORD	N	MUNICIPAL CONSERVATION - STRATFORD	WATER LOSS CONTROL	$1,489,900	2020
SUNRAY	N	DEVELOP OGALLALA AQUIFER SUPPLIES - SUNRAY	MULTIPLE WELLS/WELL FIELD	$3,526,100	2030
SUNRAY	N	MUNICIPAL CONSERVATION - SUNRAY	WATER LOSS CONTROL	$1,822,300	2020
TCW SUPPLY INC	N	DEVELOP OGALLALA AQUIFER SUPPLIES - TCW SUPPLY	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$3,890,200	2020
TCW SUPPLY INC	N	MUNICIPAL CONSERVATION - TCW SUPPLY	WATER LOSS CONTROL	$1,346,700	2020
TEXLINE	N	DEVELOP OGALLALA AQUIFER SUPPLIES - TEXLINE	SINGLE WELL	$1,056,000	2050
TEXLINE	N	MUNICIPAL CONSERVATION - TEXLINE	WATER LOSS CONTROL	$464,500	2020
VEGA	N	MUNICIPAL CONSERVATION - VEGA	WATER LOSS CONTROL	$608,100	2020
WELLINGTON	N	ADVANCED TREATMENT (NITRATE REMOVAL) - WELLINGTON	NEW WATER TREATMENT PLANT	$3,679,700	2020
WELLINGTON	N	DEVELOP SEYMOUR AQUIFER SUPPLIES - WELLINGTON	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$2,589,800	2020
WELLINGTON	N	MUNICIPAL CONSERVATION - WELLINGTON	WATER LOSS CONTROL	$1,533,900	2020
WHEELER	N	DEVELOP OGALLALA AQUIFER SUPPLIES - WHEELER	CONVEYANCE/TRANSMISSION PIPELINE; MULTIPLE WELLS/WELL FIELD	$2,795,600	2020
WHITE DEER	N	MUNICIPAL CONSERVATION - WHITE DEER	WATER LOSS CONTROL	$704,400	2020

Region A Total Recommended Capital Cost	**$865,578,050**

***Projects with a capital cost of zero are excluded from the report list.**

Water User Group (WUG) Management Supply Factor

REGION A	WUG MANAGEMENT SUPPLY FACTOR					
	2020	2030	2040	2050	2060	2070
AMARILLO	1.1	1.4	1.4	1.2	1.0	1.1
BOOKER	1.0	1.0	1.8	1.4	1.2	1.2
BORGER	3.1	3.8	3.4	3.1	2.8	2.5
CACTUS	4.1	3.1	2.4	1.8	1.4	1.1
CANADIAN	1.1	1.1	1.1	1.1	1.1	1.1
CANYON	1.2	1.2	1.3	1.1	1.0	1.0
CHILDRESS	1.1	1.1	1.1	1.1	1.1	1.1
CLARENDON	1.0	1.0	1.0	1.0	1.0	1.0
CLAUDE	1.4	1.2	2.2	2.1	2.0	1.9
COUNTY-OTHER, ARMSTRONG	1.1	1.2	1.2	1.2	1.2	1.2
COUNTY-OTHER, CARSON	1.6	1.6	1.5	1.5	1.4	1.3
COUNTY-OTHER, CHILDRESS	1.1	1.1	1.1	1.1	1.1	1.1
COUNTY-OTHER, COLLINGSWORTH	1.2	1.2	1.2	1.1	1.1	1.1
COUNTY-OTHER, DALLAM	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, DONLEY	1.1	1.1	1.2	1.2	1.2	1.2
COUNTY-OTHER, GRAY	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, HALL	1.9	1.9	1.9	1.9	1.9	1.9
COUNTY-OTHER, HANSFORD	1.4	1.4	1.3	1.2	1.1	1.1
COUNTY-OTHER, HARTLEY	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, HEMPHILL	1.4	1.4	1.4	1.4	1.4	1.4
COUNTY-OTHER, HUTCHINSON	1.5	1.4	1.4	1.4	1.3	1.3
COUNTY-OTHER, LIPSCOMB	1.1	1.1	1.1	1.0	1.0	1.0
COUNTY-OTHER, MOORE	1.3	1.3	1.3	1.3	1.3	1.3
COUNTY-OTHER, OCHILTREE	1.1	1.1	1.1	1.1	1.1	1.1
COUNTY-OTHER, OLDHAM	1.8	1.7	1.7	1.7	1.7	1.7
COUNTY-OTHER, POTTER	1.4	1.3	1.2	1.1	1.0	0.9
COUNTY-OTHER, RANDALL	1.0	1.0	1.0	1.2	1.1	1.1
COUNTY-OTHER, ROBERTS	1.3	1.3	1.3	1.3	1.3	1.3
COUNTY-OTHER, SHERMAN	1.0	1.0	1.0	1.0	1.0	1.0
COUNTY-OTHER, WHEELER	1.3	1.3	1.3	1.3	1.2	1.2
DALHART	1.8	1.6	1.4	1.2	1.1	1.0
DUMAS	1.5	1.3	1.1	1.4	1.2	1.0
FRITCH	1.1	1.1	1.1	1.1	1.1	1.1
GROOM	1.8	2.0	2.0	2.0	1.9	1.8
GRUVER	1.3	1.1	1.7	1.5	1.3	1.1
IRRIGATION, ARMSTRONG	1.1	1.2	1.3	1.4	1.4	1.5
IRRIGATION, CARSON	1.2	1.2	1.4	1.4	1.5	1.6
IRRIGATION, CHILDRESS	1.1	1.1	1.2	1.2	1.3	1.4
IRRIGATION, COLLINGSWORTH	1.1	1.1	1.2	1.2	1.2	1.3
IRRIGATION, DALLAM	0.9	0.9	1.0	1.1	1.2	1.3
IRRIGATION, DONLEY	1.1	1.2	1.2	1.2	1.3	1.4
IRRIGATION, GRAY	1.2	1.2	1.3	1.4	1.5	1.6
IRRIGATION, HALL	1.0	1.1	1.1	1.2	1.2	1.2
IRRIGATION, HANSFORD	1.1	1.1	1.3	1.3	1.4	1.5
IRRIGATION, HARTLEY	0.9	0.9	1.0	1.0	1.1	1.2
IRRIGATION, HEMPHILL	1.0	1.1	1.1	1.1	1.2	1.2
IRRIGATION, HUTCHINSON	1.1	1.2	1.3	1.4	1.5	1.6
IRRIGATION, LIPSCOMB	1.1	1.1	1.2	1.2	1.3	1.3
IRRIGATION, MOORE	1.1	1.1	1.3	1.3	1.4	1.5
IRRIGATION, OCHILTREE	1.1	1.1	1.3	1.3	1.4	1.5

Water User Group (WUG) Management Supply Factor

REGION A	WUG MANAGEMENT SUPPLY FACTOR					
	2020	2030	2040	2050	2060	2070
IRRIGATION, OLDHAM	1.0	1.0	1.0	1.0	1.0	1.0
IRRIGATION, POTTER	1.1	1.1	1.1	1.1	1.2	1.4
IRRIGATION, RANDALL	1.1	1.1	1.2	1.3	1.3	1.4
IRRIGATION, ROBERTS	1.2	1.2	1.4	1.4	1.5	1.6
IRRIGATION, SHERMAN	1.1	1.2	1.3	1.4	1.5	1.7
IRRIGATION, WHEELER	1.3	1.3	1.4	1.5	1.6	1.7
LAKE TANGLEWOOD	1.5	1.4	1.3	1.2	1.2	1.1
LIVESTOCK, ARMSTRONG	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, CARSON	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, CHILDRESS	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, COLLINGSWORTH	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, DALLAM	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, DONLEY	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, GRAY	1.6	1.5	1.5	1.5	1.4	1.4
LIVESTOCK, HALL	1.2	1.2	1.2	1.2	1.2	1.2
LIVESTOCK, HANSFORD	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HARTLEY	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HEMPHILL	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, HUTCHINSON	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, LIPSCOMB	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, MOORE	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, OCHILTREE	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, OLDHAM	1.4	1.4	1.4	1.4	1.4	1.4
LIVESTOCK, POTTER	1.4	1.4	1.4	1.4	1.4	1.4
LIVESTOCK, RANDALL	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, ROBERTS	1.3	1.3	1.3	1.3	1.3	1.3
LIVESTOCK, SHERMAN	1.0	1.0	1.0	1.0	1.0	1.0
LIVESTOCK, WHEELER	1.1	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, CARSON	2.7	2.2	1.9	1.7	1.5	1.3
MANUFACTURING, DALLAM	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, GRAY	1.1	1.0	1.1	1.0	1.0	1.0
MANUFACTURING, HANSFORD	1.6	1.5	1.5	1.6	1.6	1.6
MANUFACTURING, HARTLEY	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, HEMPHILL	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, HUTCHINSON	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, LIPSCOMB	1.0	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, MOORE	1.0	1.0	1.0	1.3	1.1	1.0
MANUFACTURING, POTTER	1.1	1.0	1.0	1.0	1.0	1.0
MANUFACTURING, RANDALL	1.0	1.4	1.3	1.2	1.1	1.1
MCLEAN	2.3	2.1	1.9	1.5	1.3	1.1
MEMPHIS	1.2	1.1	1.0	1.3	1.2	1.1
MIAMI	2.5	2.5	2.5	2.1	1.8	1.5
MINING, CARSON	1.0	1.0	1.0	1.0	1.0	1.0
MINING, GRAY	1.0	1.0	1.0	1.0	1.0	1.0
MINING, HANSFORD	1.0	1.0	1.0	1.0	1.0	1.0
MINING, HARTLEY	1.0	1.0	1.0	1.0	1.0	1.0
MINING, HEMPHILL	1.0	1.0	1.0	1.0	1.0	1.0
MINING, HUTCHINSON	1.0	1.0	1.0	1.0	1.0	1.0
MINING, LIPSCOMB	1.0	1.0	1.0	1.0	1.0	1.0
MINING, MOORE	1.0	1.0	1.0	1.0	1.0	1.0

Water User Group (WUG) Management Supply Factor

REGION A	WUG MANAGEMENT SUPPLY FACTOR					
	2020	2030	2040	2050	2060	2070
MINING, OCHILTREE	1.0	1.0	1.0	1.0	1.0	1.0
MINING, OLDHAM	1.0	1.0	1.0	1.0	1.0	1.0
MINING, POTTER	1.0	1.0	1.0	1.0	1.0	1.0
MINING, ROBERTS	1.0	1.0	1.0	1.0	1.0	1.0
MINING, SHERMAN	1.0	1.0	1.0	1.0	1.0	1.0
MINING, WHEELER	1.0	1.0	1.0	1.0	1.0	1.0
PAMPA	1.7	1.4	1.2	1.6	1.4	1.3
PANHANDLE	2.0	1.2	1.1	1.1	1.1	1.1
PERRYTON	1.4	1.2	1.0	1.3	1.2	1.0
SHAMROCK	2.8	2.7	2.5	2.3	2.1	1.9
SPEARMAN	1.0	1.0	1.0	1.6	1.3	1.1
STEAM ELECTRIC POWER, GRAY	1.0	1.0	1.0	1.0	1.0	1.0
STEAM ELECTRIC POWER, MOORE	1.0	0.0	0.0	0.0	0.0	0.0
STEAM ELECTRIC POWER, POTTER	1.0	1.0	1.0	1.0	1.0	1.0
STINNETT	1.2	1.1	1.1	1.3	1.2	1.1
STRATFORD	2.7	2.6	2.5	2.2	1.8	1.4
SUNRAY	1.3	2.2	1.6	1.4	1.2	1.1
TCW SUPPLY INC	1.8	1.5	1.3	1.2	1.1	1.1
TEXLINE	1.1	1.1	1.1	1.4	1.2	1.0
VEGA	1.1	1.1	1.1	1.1	1.1	1.1
WELLINGTON	1.4	1.3	1.3	1.3	1.3	1.2
WHEELER	1.7	1.5	1.4	1.3	1.2	1.1
WHITE DEER	1.1	1.1	1.1	1.1	1.1	1.1

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. To calculate the Management Supply Factor for each WUG as a whole, not split by region-county-basin the combined total of existing and future supply is divided by the total projected demand.

Water User Group (WUG) Unmet Needs

REGION A	WUG UNMET NEEDS (ACRE-FEET PER YEAR)					
	2020	2030	2040	2050	2060	2070
DALLAM COUNTY						
CANADIAN BASIN						
IRRIGATION	45,181	30,501	0	0	0	0
HARTLEY COUNTY						
CANADIAN BASIN						
IRRIGATION	48,108	41,207	8,174	0	0	0
POTTER COUNTY						
CANADIAN BASIN						
COUNTY-OTHER	0	0	0	0	0	467
RED BASIN						
COUNTY-OTHER	0	0	0	0	0	68

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. In order to display only unmet needs associated with the WUG split, these surplus volumes are updated to a zero and the unmet needs water volumes are shown as absolute values.

Water User Group (WUG) Unmet Needs Summary

REGION A

	2020	2030	2040	2050	2060	2070
MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	0	0	0	0	0	535
MANUFACTURING	0	0	0	0	0	0
MINING	0	0	0	0	0	0
STEAM ELECTRIC POWER	0	0	0	0	0	0
LIVESTOCK	0	0	0	0	0	0
IRRIGATION	93,289	71,708	8,174	0	0	0

*WUG supplies and projected demands are entered for each of a WUG's region-county-basin divisions. The unmet needs shown in the WUG Unmet Needs Summary report are calculated by first deducting the WUG split's projected demand from the sum of its total existing water supply volume and all associated recommended water management strategy water volumes. If the WUG split has a greater future supply volume than projected demand in any given decade, this amount is considered a surplus volume. Before aggregating the difference between supplies and demands to the WUG category level, calculated surpluses are updated to zero so that only the WUGs with unmet needs in the decade are included with the Needs totals. Unmet needs water volumes are shown as absolute values.

Alternative Water User Group (WUG) Water Management Strategies (WMS)

WUG Entity Primary Region: A

WUG Entity Name	WMS Sponsor Region	WMS Name	Source Name	Water Management Strategy Supplies 2020	2030	2040	2050	2060	2070	Unit Cost 2020	Unit Cost 2070
AMARILLO	A	DIRECT REUSE - AMARILLO	A | DIRECT REUSE	6,100	6,100	6,100	6,100	6,100	6,100	$1368	$496
MANUFACTURING, POTTER	A	DIRECT REUSE - POTTER COUNTY MANUFACTURING	A | DIRECT REUSE	0	0	5,700	5,700	5,700	5,700	N/A	$464
PALO DURO RIVER AUTHORITY - UNASSIGNED WATER VOLUMES	A	CONNECTING TO PALO DURO RESERVOIR	A | PALO DURO LAKE/RESERVOIR	0	3,875	3,833	3,792	3,750	3,708	N/A	$810
Region A Total Alternative WMS Supplies				6,100	9,975	15,633	15,592	15,550	15,508		

Alternative Projects Associated with Water Management Strategies

Project Sponsor Region: A

Sponsor Name	Is Sponsor a WWP?	Project Name	Project Description	Capital Cost	Online Decade
AMARILLO	Y	DIRECT REUSE - AMARILLO	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; WATER TREATMENT PLANT EXPANSION	$63,566,200	2030
MANUFACTURING, POTTER	N	DIRECT REUSE - POTTER COUNTY MANUFACTURING	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT	$57,732,350	2040
PALO DURO RIVER AUTHORITY	Y	CONNECTING TO PALO DURO RESERVOIR	CONVEYANCE/TRANSMISSION PIPELINE; NEW WATER TREATMENT PLANT; PUMP STATION	$139,574,500	2030

Region A Total Alternative Capital Cost	**$260,873,050**

***Projects with a capital cost of zero are excluded from the report list.**

WWP DEMAND

AMARILLO

CUSTOMER	WUG	County	Basin	USE TYPE	WWP DEMAND (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
AMARILLO	AMARILLO	POTTER	CANADIAN	MUNICIPAL	15,884	17,294	18,856	20,510	22,424	24,462
AMARILLO	AMARILLO	POTTER	RED	MUNICIPAL	10,458	11,386	12,414	13,504	14,764	16,106
AMARILLO	AMARILLO	RANDALL	RED	MUNICIPAL	21,389	23,430	25,540	27,846	30,443	33,171
MANUFACTURING	MANUFACTURING	POTTER	CANADIAN	MANUFACTURING	1,020	1,098	1,175	1,240	1,332	1,430
MANUFACTURING	MANUFACTURING	POTTER	RED	MANUFACTURING	5,779	6,225	6,659	7,036	7,552	8,105
CANYON	CANYON	RANDALL	RED	MUNICIPAL	1,000	1,000	1,000	1,000	0	0
MANUFACTURING	MANUFACTURING	RANDALL	RED	MANUFACTURING	550	550	550	550	550	550
PALO DURO STATE PARK	COUNTY-OTHER	RANDALL	RED	MUNICIPAL	25	25	25	25	25	25
STEAM ELECTRIC	STEAM ELECTRIC	POTTER	CANADIAN	STEAM ELECTRIC	25,387	26,804	28,408	30,011	34,115	37,669
AMARILLO TOTAL DEMAND					**81,492**	**87,812**	**94,627**	**101,722**	**111,205**	**121,518**

BORGER

CUSTOMER	WUG	County	Basin	USE TYPE	WWP DEMAND (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
BORGER	BORGER	HUTCHINSON	CANADIAN	MUNICIPAL	3,215	3,254	3,234	3,229	3,225	3,224
COUNTY-OTHER	COUNTY-OTHER	HUTCHINSON	CANADIAN	MUNICIPAL	56	57	57	55	52	49
MANUFACTURING	MANUFACTURING	CARSON	CANADIAN	MANUFACTURING	20	28	35	43	54	67
MANUFACTURING	MANUFACTURING	CARSON	RED	MANUFACTURING	430	422	415	407	396	383
MANUFACTURING	MANUFACTURING	HUTCHINSON	CANADIAN	MANUFACTURING	6,337	6,707	7,062	7,371	7,885	8,435
BORGER TOTAL DEMAND					**10,058**	**10,468**	**10,803**	**11,105**	**11,612**	**12,158**

CACTUS

CUSTOMER	WUG	County	Basin	USE TYPE	WWP DEMAND (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
CACTUS	CACTUS	MOORE	CANADIAN	MUNICIPAL	985	1,108	1,242	1,382	1,532	1,686
COUNTY-OTHER	COUNTY-OTHER	MOORE	CANADIAN	MUNICIPAL	98	108	119	132	146	160
MANUFACTURING	MANUFACTURING	MOORE	CANADIAN	MANUFACTURING	3,168	3,342	3,513	3,664	3,913	4,178
CACTUS TOTAL DEMAND					**4,251**	**4,558**	**4,874**	**5,178**	**5,591**	**6,024**

CANADIAN RIVER MUNICIPAL WATER AUTHORITY

CUSTOMER	WUG	COUNTY	BASIN	USE TYPE	WWP DEMAND (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
LAMESA	LAMESA	DAWSON	COLORADO	MUNICIPAL	1,534	1,950	2,300	2,750	2,750	2,750
O'DONNELL	O'DONNELL	DAWSON	BRAZOS	MUNICIPAL	20	20	23	22	24	24
O'DONNELL	O'DONNELL	LYNN	BRAZOS	MUNICIPAL	117	119	119	124	126	129
PAMPA	PAMPA	GRAY	CANADIAN	MUNICIPAL	1,818	1,827	1,836	4,680	4,680	4,680
PLAINVIEW	PLAINVIEW	HALE	BRAZOS	MUNICIPAL	2,761	3,000	3,250	3,500	3,500	3,500
LEVELLAND	LEVELLAND	HOCKLEY	BRAZOS	MUNICIPAL	2,301	2,400	2,500	2,588	2,671	2,743
BORGER	WWP	WWP	WWP	WWP	7,054	7,091	7,072	7,068	7,064	7,063
LUBBOCK	LUBBOCK	LUBBOCK	BRAZOS	MUNICIPAL	35,600	39,000	43,500	47,000	47,000	47,000
SLATON	SLATON	LUBBOCK	BRAZOS	MUNICIPAL	1,405	1,430	1,455	1,479	1,477	1,477
TAHOKA	TAHOKA	LYNN	BRAZOS	MUNICIPAL	460	477	483	496	507	517
AMARILLO	WWP	WWP	WWP	WWP	46,000	50,000	50,000	50,000	50,000	50,000
BROWNFIELD	BROWNFIELD	TERRY	COLORADO	MUNICIPAL	1,380	1,500	1,600	1,750	1,750	1,750
CANADIAN RIVER MUNICIPAL WATER AUTHORITY TOTAL DEMAND					**100,450**	**108,814**	**114,138**	**121,457**	**121,549**	**121,633**

WWP DEMAND

GREENBELT MIWA										
					WWP DEMAND (ACRE-FEET PER YEAR)					
CUSTOMER	WUG	County	Basin	USE TYPE	2020	2030	2040	2050	2060	2070
CHILDRESS	CHILDRESS	CHILDRESS	RED	MUNICIPAL	1,624	1,658	1,686	1,722	1,768	1,814
CHILLICOTHE	CHILLICOTHE	HARDEMAN	RED	MUNICIPAL	65	63	60	61	62	62
CLARENDON	CLARENDON	DONLEY	RED	MUNICIPAL	378	369	361	356	356	356
CROWELL	CROWELL	FOARD	RED	MUNICIPAL	138	134	132	131	131	131
MEMPHIS	MEMPHIS	HALL	RED	MUNICIPAL	100	100	100	100	100	100
COUNTY-OTHER	COUNTY-OTHER	CHILDRESS	RED	MUNICIPAL	178	184	189	194	200	204
COUNTY-OTHER	COUNTY-OTHER	DONLEY	RED	MUNICIPAL	95	95	95	95	95	95
COUNTY-OTHER	COUNTY-OTHER	FOARD	RED	MUNICIPAL	50	50	50	50	50	50
COUNTY-OTHER	COUNTY-OTHER	HALL	RED	MUNICIPAL	92	92	92	92	92	92
COUNTY-OTHER	COUNTY-OTHER	HARDEMAN	RED	MUNICIPAL	60	60	60	60	60	60
MANUFACTURING	MANUFACTURING	HARDEMAN	RED	MANUFACTURING	276	294	313	332	332	332
QUANAH	QUANAH	HARDEMAN	RED	MUNICIPAL	397	391	388	394	397	400
GREENBELT TOTAL DEMAND					**3,453**	**3,490**	**3,526**	**3,587**	**3,643**	**3,696**

WWP (NEEDS)/SURPLUS

AMARILLO

CUSTOMER	WUG	COUNTY	BASIN	USE TYPE	WWP (NEEDS)/SURPLUS (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
AMARILLO	AMARILLO	POTTER	CANADIAN	MUNICIPAL	(1,501)	(4,129)	(7,241)	(10,389)	(13,215)	(16,315)
AMARILLO	AMARILLO	POTTER	RED	MUNICIPAL	(987)	(2,719)	(4,767)	(6,840)	(8,703)	(10,742)
AMARILLO	AMARILLO	RANDALL	RED	MUNICIPAL	(2,020)	(5,593)	(9,807)	(14,105)	(17,944)	(22,125)
MANUFACTURING	MANUFACTURING	POTTER	CANADIAN	MANUFACTURING	(96)	(262)	(451)	(628)	(785)	(954)
MANUFACTURING	MANUFACTURING	POTTER	RED	MANUFACTURING	(546)	(1,487)	(2,557)	(3,564)	(4,451)	(5,406)
CANYON	CANYON	RANDALL	RED	MUNICIPAL	(94)	(239)	(384)	(507)	0	0
MANUFACTURING	MANUFACTURING	RANDALL	RED	MANUFACTURING	(52)	(131)	(211)	(279)	(324)	(367)
PALO DURO STATE PARK	COUNTY-OTHER	RANDALL	RED	MUNICIPAL	(2)	(6)	(10)	(13)	(15)	(17)
STEAM ELECTRIC	STEAM ELECTRIC	POTTER	CANADIAN	STEAM ELECTRIC	0	0	0	0	0	0
AMARILLO TOTAL NEEDS/SURPLUS					**(5,298)**	**(14,566)**	**(25,428)**	**(36,325)**	**(45,437)**	**(55,926)**

BORGER

CUSTOMER	WUG	County	Basin	USE TYPE	WWP (NEEDS)/SURPLUS (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
BORGER	BORGER	HUTCHINSON	CANADIAN	MUNICIPAL	(92)	(531)	(952)	(1,343)	(1,647)	(1,927)
COUNTY-OTHER	COUNTY-OTHER	HUTCHINSON	CANADIAN	MUNICIPAL	(1)	(9)	(16)	(22)	(26)	(28)
MANUFACTURING	MANUFACTURING	CARSON*	CANADIAN	MANUFACTURING	5	0	(5)	(11)	(19)	(30)
MANUFACTURING	MANUFACTURING	CARSON*	RED	MANUFACTURING	106	7	(54)	(102)	(138)	(172)
MANUFACTURING	MANUFACTURING	HUTCHINSON	CANADIAN	MANUFACTURING	26	(802)	(1,652)	(2,504)	(3,360)	(4,281)
BORGER TOTAL NEEDS/SURPLUS					**44**	**(1,335)**	**(2,679)**	**(3,982)**	**(5,190)**	**(6,438)**
BORGER TOTAL NEEDS ONLY					**(93)**	**(1,342)**	**(2,679)**	**(3,982)**	**(5,190)**	**(6,438)**

*Carson County Manufacturing has a sepearate well field which can produce more supply than their demand. However, there is not infrastructure in place for this supply to be used in other portions of the system. This results in a surplus for Manufacturing, while other users have a need.

CACTUS

CUSTOMER	WUG	County	Basin	USE TYPE	WWP (NEEDS)/SURPLUS (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
CACTUS	CACTUS	MOORE	CANADIAN	MUNICIPAL	(583)	(777)	(974)	(1,170)	(1,347)	(1,530)
COUNTY-OTHER	COUNTY-OTHER	MOORE	CANADIAN	MUNICIPAL	(58)	(76)	(93)	(112)	(128)	(145)
MANUFACTURING	MANUFACTURING	MOORE	CANADIAN	MANUFACTURING	(1,877)	(2,346)	(2,754)	(3,102)	(3,439)	(3,790)
CACTUS TOTAL NEEDS/SURPLUS					**(2,518)**	**(3,199)**	**(3,821)**	**(4,384)**	**(4,914)**	**(5,465)**

CANADIAN RIVER MUNICIPAL WATER AUTHORITY

CUSTOMER	WUG	COUNTY	BASIN	USE TYPE	WWP (NEEDS)/SURPLUS (ACRE-FEET PER YEAR) 2020	2030	2040	2050	2060	2070
LAMESA	LAMESA	DAWSON	COLORADO	MUNICIPAL	(31)	(866)	(1,182)	(1,607)	(1,719)	(1,830)
O'DONNELL	O'DONNELL	DAWSON	BRAZOS	MUNICIPAL	8	(9)	(12)	(13)	(15)	(16)
O'DONNELL	O'DONNELL	LYNN	BRAZOS	MUNICIPAL	47	(53)	(61)	(72)	(79)	(86)
PAMPA	PAMPA	GRAY	CANADIAN	MUNICIPAL	666	(812)	(943)	(2,735)	(2,925)	(3,114)
PLAINVIEW	PLAINVIEW	HALE	BRAZOS	MUNICIPAL	(214)	(1,333)	(1,670)	(2,045)	(2,187)	(2,329)
LEVELLAND	LEVELLAND	HOCKLEY	BRAZOS	MUNICIPAL	(375)	(1,066)	(1,284)	(1,512)	(1,669)	(1,825)
BORGER	WWP	WWP	WWP	MUNICIPAL	(3,225)	(3,262)	(3,633)	(4,130)	(4,414)	(4,700)
LUBBOCK	LUBBOCK	LUBBOCK	BRAZOS	MUNICIPAL	(10,031)	(17,277)	(22,347)	(27,465)	(29,371)	(31,274)
SLATON	SLATON	LUBBOCK	BRAZOS	MUNICIPAL	(318)	(635)	(747)	(864)	(923)	(983)
TAHOKA	TAHOKA	LYNN	BRAZOS	MUNICIPAL	(143)	(212)	(248)	(290)	(317)	(344)
AMARILLO	WWP	WWP	WWP	MUNICIPAL	(17,971)	(22,159)	(25,687)	(29,218)	(31,246)	(33,271)
BROWNFIELD	BROWNFIELD	TERRY	COLORADO	MUNICIPAL	137	(667)	(822)	(1,023)	(1,094)	(1,164)
CANADIAN RIVER MUNICIPAL WATER AUTHORITY TOTAL NEEDS/SURPLUS					**(31,450)**	**(48,351)**	**(58,636)**	**(70,974)**	**(75,959)**	**(80,936)**
CANADIAN RIVER MUNICIPAL WATER AUTHORITY TOTAL NEED ONLY					**(32,308)**	**(48,351)**	**(58,636)**	**(70,974)**	**(75,959)**	**(80,936)**

*Supplies were allocated based on contract amounts which, in some cases, are greater than their TWDB demand. This results in some users having surpluses while others have needs.

WWP (NEEDS)/SURPLUS

GREENBELT MWA										
					WWP (NEEDS)/SURPLUS (ACRE-FEET PER YEAR)					
CUSTOMER	**WUG**	**County**	**Basin**	**USE TYPE**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
CHILDRESS	CHILDRESS	CHILDRESS	RED	MUNICIPAL	0	0	0	0	0	0
CHILLICOTHE	CHILLICOTHE	HARDEMAN	RED	MUNICIPAL	0	0	0	0	0	0
CLARENDON	CLARENDON	DONLEY	RED	MUNICIPAL	0	0	0	0	0	0
CROWELL	CROWELL	FOARD	RED	MUNICIPAL	0	0	0	0	0	0
MEMPHIS	MEMPHIS	HALL	RED	MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	COUNTY-OTHER	CHILDRESS	RED	MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	COUNTY-OTHER	DONLEY	RED	MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	COUNTY-OTHER	FOARD	RED	MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	COUNTY-OTHER	HALL	RED	MUNICIPAL	0	0	0	0	0	0
COUNTY-OTHER	COUNTY-OTHER	HARDEMAN	RED	MUNICIPAL	0	0	0	0	0	0
MANUFACTURING	MANUFACTURING	HARDEMAN	RED	MANUFACTURING	0	0	0	0	0	0
QUANAH	QUANAH	HARDEMAN	RED	MUNICIPAL	0	0	0	0	0	0
GREENBELT TOTAL NEEDS/SURPLUS					**0**	**0**	**0**	**0**	**0**	**0**