

Section 3

Water Supply Analysis

[31 TAC §357.7(a)(3)]

The Llano Estacado Region is located in a semiarid climatic area of west Texas. Precipitation ranges from an average annual level of about 18 inches on the eastern border to only about 14 inches on the west at the New Mexico state line. Therefore, surface water supplies are very low. However, the region is underlain with aquifers in which large quantities of water have been captured and stored over very long periods of time. The ground and surface water resources of the region are identified and described below.

3.1 Groundwater

The major sources of water in the Llano Estacado Region are the Ogallala, Seymour, Edwards-Trinity (High Plains), and Dockum Aquifers. Each of these aquifers is identified and characterized briefly below. A more complete description of these aquifers is presented in Section 1, and is not repeated here.

3.1.1 Ogallala Aquifer

The Ogallala Aquifer is the major water-bearing formation in most of the 21 counties of the Llano Estacado Region. Most of the communities within the region obtain water from the Ogallala Aquifer as their primary source of drinking water; however, approximately 95 percent of the water obtained from the Ogallala is used for irrigation.

3.1.2 Seymour Aquifer

The Seymour Formation consists of isolated areas of alluvium found in parts of 23 north-central and High Plains counties, including parts of Briscoe, Motley, Dickens, and Crosby Counties of the Llano Estacado Region. The Seymour Aquifer supplies small quantities of water for municipal and irrigation use in these four counties.

3.1.3 Edwards-Trinity (High Plains) Aquifer

The Edwards-Trinity (High Plains) Aquifer includes Cretaceous Age water-bearing formations of the Fredericksburg and Trinity Groups. These formations underlie the Ogallala Formation in 11 counties in the southwestern corner of the Llano Estacado Region and extend

westward into New Mexico. The Edwards-Trinity (High Plains) Aquifer supplies water for municipal and irrigation use in Lynn County.

3.1.4 Dockum (Santa Rosa) Aquifer

The Dockum Group of Triassic Age underlies the Ogallala Formation of the High Plains area of Texas and New Mexico, the northern part of the Edwards Plateau, and the eastern part of the Cenozoic Pecos Alluvium. The Dockum Aquifer supplies small quantities of water for municipal and irrigation use in Briscoe, Deaf Smith, Garza, and Swisher Counties.

3.2 Surface Water

Although the Llano Estacado Region lies within the headwaters areas of the Canadian, Red, Brazos, and Colorado River Basins, the region has very little surface water; rainfall is less than 18 inches per year, and is not adequate to result in any sustained runoff to streams. Even though streamflow in the region is relatively low, four dams and reservoirs (Lake Meredith, Mackenzie, White River, and Alan Henry) have been built within and near the region to capture and store most of the surface water that is available from the streams on which they are located. The four reservoirs supply water for municipal and industrial uses to 15 of the 46 cities located in the region. These four reservoirs are described below. In segments of rivers where dams have not been built, surface water amounts to a trickle, with very little water leaving the region. Those entities that do not obtain water from the reservoirs mentioned above must rely upon groundwater to supply their water needs due to the lack of a reliable surface water source.

There are a limited number of surface water rights within the region; however, none of these rights are reliable during a drought according the Texas Commission on Environmental Quality's (TCEQ) WAM model. A total of 94 water rights, included rights for reservoirs, exist in the Llano Estacado Region, with a total authorized diversion of approximately 116,500 acft/yr. It is important to note that a small percentage of the water rights make up a large percentage of the authorized diversion volume. In the region, five water rights (5.3 percent) make up 100,910 acft/yr (86.6 percent) of the authorized diversion volume. The remaining 89 water rights primarily consists of small irrigation and municipal rights distributed throughout the region. Appendix F contains a list of all surface water rights in the region and their authorized diversion volumes.

3.2.1 Lake Meredith

Lake Meredith, operated by the CRMWA, is located in the Canadian River Basin to the north of the Llano Estacado Region, in Potter, Moore, and Hutchinson Counties. From Lake Meredith, a pipeline extends southward and delivers water for municipal and industrial purposes to Brownfield, Lamesa, Levelland, Lubbock, Plainview, O'Donnell, Slaton, and Tahoka of the Llano Estacado Region. The lake has a total storage capacity of 920,300 acft, a firm yield of approximately 69,750 acft of water per year, and a safe yield of 63,750 acft per year. Groundwater projects that obtain water from the Ogallala Aquifer in Roberts County have been added to increase the supply to entities obtaining water from Lake Meredith. In addition, this water from the Ogallala Aquifer is firming up the reliability and improving the quality of current supplies from Lake Meredith.

3.2.2 Mackenzie Reservoir

Mackenzie Reservoir is located in the Red River Basin in Swisher and Briscoe Counties. Mackenzie Reservoir has a total storage capacity of 45,500 acft and can supply approximately 5,200 acft of water per year when the reservoir is at conservation pool elevation. Mackenzie Reservoir supplies water to Silverton, Tulia, Floydada, and Lockney. However, during recent dry years, Mackenzie Reservoir was unable to meet its contracted demands.

3.2.3 White River Lake

White River Lake is located in the Brazos River Basin in the southeast corner of Crosby County. It is owned and operated by the WRMWD, which supplies water to Ralls, Spur, Post, and Crosbyton. The lake has a surface area of 1,808 acres at conservation pool elevation, a drainage area of 173 square miles, total storage capacity of 31,846 acft, and can supply approximately 4,000 acft/yr when at conservation pool elevation. WRMWD has purchased groundwater rights and has drilled wells to augment its supply to customers should the water levels in the reservoir drop below the level at which water can be removed.

3.2.4 Lake Alan Henry

Lake Alan Henry, owned by the City of Lubbock, Texas, is located on the Double Mountain Fork of the Brazos River in Garza and Kent Counties. TCEQ Permit 4146, with Priority Date of October 5, 1981, authorizes impoundment of 115,937 acft and the diversion of

up to 35,000 acft/yr of water for municipal purposes. Based upon the hydrologic record for the period 1940 through 2002, the firm yield of Lake Alan Henry was calculated at 22,500 acft/yr.¹ Lake Alan Henry was developed to serve as a future water supply for the City of Lubbock and at present is open for recreational purposes. In addition, Lubbock has contracted to sell 520 acft/yr to the Lake Alan Henry Water Supply District, and 20 acft/yr to the South Garza Water Supply Corporation. The Lake Alan Henry and South Garza Water Supply Districts will supply municipal water to developing areas in southeastern Garza County of the Llano Estacado Region and western Kent County of the neighboring Brazos G Water Planning Region.

3.2.5 Surface Water Rights

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3.3 Methodology to Calculate the Water Supplies Available to the Llano Estacado Region and Methodology for Calculating Water Supplies Available for Water User Groups

The water supplies available to the Llano Estacado Region during the 1947--1957 "drought of record" were calculated from the following data sources:

- A. The LERWPG requested that TWDB run the Southern Ogallala Groundwater Availability Model (GAM) using the water demand projections for water user groups (WUGs) of LERWPG, as approved by the TWDB on September 17, 2003, for the planning period of 2010 through 2060. The TWDB performed the runs, as requested, and provided information showing the volume of groundwater present in each county-basin area of the Llano Estacado Region (Region O) for each of the projection dates 2004,

¹ "Draft Memorandum to File," Gooch, Thomas C., P.E., and Andres A. Salazar, Ph.D., Freese and Nichols, March 19, 2003.

² "Draft Memorandum to File," Gooch, Thomas C., P.E., and Andres A. Salazar, Ph.D., Freese and Nichols, March 19, 2003.

2010, 2020, 2030, 2040, 2050 and 2060. The quantity of water that could be pumped from each of the county-basin areas at each of the projection dates was calculated based upon the recharge and aquifer parameters of the Southern Ogallala GAM, and the water wells in place at the present time (the quantity of water available annually from the aquifer in the immediate future could be increased by adding more wells). However, well spacing is regulated by the Underground Water Conservation Districts of the area, and the addition of wells requires permits from the Districts. In a second request by the LERWPG, the TWDB made volumetric calculations for the counties in the region using a mass balance approach with 1995 as the base starting point and continuing through 2060 with only average recharge from the model as the primary input and projected water demands, as approved by the TWDB on September 17, 2003, as the primary output. The results of the GAM and the mass balance calculations were used to obtain estimates of the quantities of water available from the Ogallala Aquifer for use in meeting projected water demand of the region (see Appendix E).

- B. Groundwater availability by aquifer for the Dockum, Edwards-Trinity (High Plains), and Seymour Aquifers was obtained from the TWDB. The groundwater availability by county was further subdivided into river basin parts of each county according to the TWDB estimates.
- C. Surface water availability for cities obtaining all or part of their water supply from surface water sources was estimated from water use data supplied by surface water suppliers and cities within the planning region that use surface water.
- D. Water availability from reclaimed water was obtained from TCEQ discharge permits.
- E. Range livestock water supply was allocated to local sources (stock tanks and windmills) and set at projected quantities of range livestock water demands.

The estimated quantity of water available from each source (Aquifer and Surface Source) to meet projected water demands in each county-basin area of the planning region is presented in Table 3-1 and Tables 4-1 through 4-21.

3.4 Projected Water Supplies Available to the Llano Estacado Region

Water demand projections for water user groups of each county and river basin area of the Llano Estacado Region were presented in Section 2, Table 2-21. The projected quantity of water available from each aquifer and other water source for use in each county and river basin area of each county of the Llano Estacado Region is presented below. The water supply information is explained briefly below for Bailey and Castro Counties and for the region. The explanations for Bailey and Castro Counties are illustrative as to how to read Table 3-1.

The total quantity of water used in Bailey County, which is located entirely in the Brazos River Basin, in 2000 was 187,506 acft (Table 3-1). The quantity estimated to be available for

use in 2010 is 111,641 acft, of which 110,276 acft are from the Ogallala Aquifer, 541 acft are from stock tanks and windmills, and 825 acft are reclaimed wastewater (Table 3-1). The projected quantity available in 2060 in Bailey County is 84,617 acft, which is only 45 percent as much as was available in 2000 (Table 3-1). The reason for the decline in quantity available between 2000 and 2060 is the decline in the quantity available from the Ogallala Aquifer (i.e., more water is being withdrawn from the aquifer than is being recharged to it).

The total quantity of water used in Castro County, which is located partially in the Red River Basin and partially in the Brazos River Basin, in 2000 was 517,384 acft (Table 3-1). The quantity estimated to be available for use in 2010 is 350,128 acft, of which 110,256 acft are from the Ogallala Aquifer in the Red River Basin and 235,507 acft are from the Ogallala Aquifer in the Brazos River Basin, 151 acft are from stock tanks and windmills in the Red River Basin and 184 acft are from stock tanks and windmills in the Brazos River Basin. In addition, in 2010 Castro County has available a projected quantity of 4,031 acft of reclaimed wastewater in the Brazos River Basin (Table 3-1). The projected quantity available in 2060 in Castro County is 63,402 acft, which is only 12 percent as much as was available in 2000, with the reason for the decline in quantity available between 2000 and 2060 the same as for Bailey County (i.e., more water is being withdrawn from the Ogallala Aquifer than is being recharged to it) (Table 3-1).

The total quantity of water used in the Llano Estacado Region in 2000 was 4,667,387 acft, of which 96.44 percent was from the Ogallala Aquifer, 0.83 percent was from Lake Meredith of the CRMWA System, and 1.09 percent was from reclaimed wastewater (Table 3-1). The estimated total quantity of water available for use in the Region in 2060 is 1,483,417 acft, or only 31.78 percent as much as was available in 2000. As was explained above for Bailey and Castro Counties, more water is being withdrawn from the Ogallala Aquifer than is being recharged to it (Table 3-1 and Figure 3-1).

The Ogallala Aquifer supplied 96 percent of the water used in the Llano Estacado Region in 2000, and even though the quantity available annually from the Ogallala Aquifer is projected to decline from 4.50 million acft/yr in 2000 to 1.33 million acft/yr in 2060, it is still projected to provide about 89.5 percent of the region's total water supply in 2060 (Table 3-1 and Figure 3-1).

**Table 3-1
Water Supply Projections
Individual Counties with River Basin Summaries
Llano Estacado Region**

Counties	River Basin	Source	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Bailey	Brazos	Ogallala Aquifer	186,162	110,276	100,461	95,662	90,331	86,250	83,125
Bailey	Brazos	Stock Tanks and Windmills	519	541	563	587	612	639	667
Bailey	Brazos	Reclaimed	825	825	825	825	825	825	825
Bailey		Total	187,506	111,641	101,849	97,074	91,768	87,714	84,617
Briscoe	Red	Ogallala Aquifer	26,952	22,800	15,867	9,872	7,460	5,388	4,888
Briscoe	Red	Dockum Aquifer	100	100	100	100	100	100	100
Briscoe	Red	Seymour Aquifer	4,063	4,063	4,063	1,821	1,821	1,821	1,821
Briscoe	Red	Other Aquifers	115	109	96	94	95	91	91
Briscoe	Red	Stock Tanks and Windmills	284	292	301	310	320	330	341
Briscoe	Red	Lake Mackenzie	85	0	0	0	0	0	0
Briscoe		Total	31,599	27,364	20,427	12,197	9,797	7,731	7,241
Castro	Red	Ogallala Aquifer	163,591	110,256	72,609	45,405	25,992	23,784	20,890
Castro	Red	Stock Tanks and Windmills	149	151	176	178	181	185	188
Castro	Brazos	Ogallala Aquifer	349,432	235,507	211,116	147,124	59,674	44,832	38,066
Castro	Brazos	Stock Tanks and Windmills	181	184	214	218	220	223	227
Castro	Brazos	Reclaimed	4,031	4,031	4,031	4,031	4,031	4,031	4,031
Castro		Total	517,384	350,128	288,146	196,957	90,099	73,055	63,402
Cochran	Brazos	Ogallala Aquifer	77,961	44,285	43,420	36,681	33,797	12,126	12,157
Cochran	Brazos	Stock Tanks and Windmills	45	46	64	67	69	70	70
Cochran	Brazos	Reclaimed	267	267	267	267	267	267	267
Cochran	Colorado	Ogallala Aquifer	45,154	33,836	31,610	35,447	35,458	11,783	11,752
Cochran	Colorado	Stock Tanks and Windmills	87	88	123	123	124	125	128
Cochran	Colorado	Reclaimed	27	27	27	27	27	27	27
Cochran		Total	123,542	78,550	75,511	72,612	69,742	24,398	24,401
Crosby	Red	Ogallala Aquifer	1,391	1,307	1,256	1,204	1,158	1,101	1,078
Crosby	Red	Stock Tanks and Windmills	3	3	3	4	4	4	4
Crosby	Brazos	Ogallala Aquifer	112,337	96,710	92,844	89,147	85,593	83,138	79,835
Crosby	Brazos	Seymour Aquifer	483	483	483	474	474	474	474
Crosby	Brazos	Stock Tanks and Windmills	292	298	303	310	318	325	332
Crosby	Brazos	White River Reservoir	707	707	707	707	707	389	8
Crosby	Brazos	Reclaimed	583	583	583	583	583	583	583
Crosby		Total	115,796	100,091	96,179	92,430	88,836	86,014	82,314
Dawson	Brazos	Ogallala Aquifer	19	19	19	19	18	18	17
Dawson	Brazos	Stock Tanks and Windmills	1	1	2	1	2	2	2
Dawson	Colorado	Ogallala Aquifer	152,146	45,194	37,508	34,547	31,266	31,239	31,195
Dawson	Colorado	Ogallala (Roberts Co.)	892	1,708	1,486	1,486	1,486	1,369	1,369
Dawson	Colorado	Stock Tanks and Windmills	150	154	156	161	164	168	172
Dawson	Colorado	Lake Meredith (CRMWA)	1,694	854	1,076	1,076	1,076	992	992
Dawson		Total	154,903	47,930	40,247	37,290	34,012	33,788	33,747

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Table 3-1 Continued

Counties	River Basin	Source	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Deaf Smith	Canadian	Ogallala Aquifer	171	112	74	1	1	1	1
Deaf Smith	Canadian	Stock Tanks and Windmills	220	281	317	326	336	344	353
Deaf Smith	Red	Ogallala Aquifer	388,182	204,702	170,696	128,078	88,180	86,199	81,704
Deaf Smith	Red	Dockum Aquifer	930	720	578	7,502	7,576	7,602	7,602
Deaf Smith	Red	Stock Tanks and Windmills	2,859	2,931	3,035	3,174	3,319	3,474	3,636
Deaf Smith	Red	Reclaimed	2,810	2,810	2,810	2,810	2,810	2,810	2,810
Deaf Smith		Total	395,172	211,556	177,511	141,891	102,222	100,430	96,106
Dickens	Red	Ogallala Aquifer	4,626	2,662	2,575	2,503	2,217	2,159	2,108
Dickens	Red	Seymour Aquifer	7,937	7,937	7,937	5,217	5,217	5,217	5,217
Dickens	Red	Stock Tanks and Windmills	230	233	239	246	251	258	264
Dickens	Brazos	Ogallala Aquifer	6,199	3,585	3,468	3,366	3,481	3,390	3,312
Dickens	Brazos	Seymour Aquifer	4,348	4,348	4,348	2,858	2,858	2,858	2,858
Dickens	Brazos	Stock Tanks and Windmills	391	401	408	417	427	437	449
Dickens	Brazos	White River Reservoir	275	271	267	263	260	106	0
Dickens		Total	24,005	19,437	19,243	14,869	14,711	14,425	14,207
Floyd	Red	Ogallala Aquifer	101,292	52,505	32,434	25,205	21,096	20,270	19,510
Floyd	Red	Stock Tanks and Windmills	253	259	266	271	279	288	296
Floyd	Brazos	Ogallala Aquifer	138,280	86,288	81,860	78,044	73,821	70,449	68,588
Floyd	Brazos	Stock Tanks and Windmills	199	205	210	218	223	229	236
Floyd	Brazos	Lake Mackenzie	362	0	0	0	0	0	0
Floyd	Brazos	Reclaimed	449	449	449	449	449	449	449
Floyd		Total	240,835	139,706	115,219	104,187	95,868	91,685	89,079
Gaines	Colorado	Ogallala Aquifer	424,778	335,917	275,995	241,173	213,273	188,235	165,735
Gaines	Colorado	Stock Tanks and Windmills	296	304	312	320	329	338	348
Gaines		Total	425,074	336,221	276,307	241,493	213,602	188,573	166,083
Garza	Brazos	Ogallala Aquifer	14,563	7,527	6,879	6,394	5,946	5,554	5,262
Garza	Brazos	Dockum Aquifer	136	136	136	136	136	136	136
Garza	Brazos	Stock Tanks and Windmills	355	363	423	432	442	453	465
Garza	Brazos	White River Reservoir	1,021	1,021	973	493	12	0	0
Garza	Brazos	Lake Alan Henry (WSD)	0	540	540	540	540	540	540
Garza	Brazos	Slaton CRMWA Supply	0	306	306	306	306	306	306
Garza	Colorado	Ogallala Aquifer	0	0	0	0	0	0	0
Garza	Colorado	Stock Tanks and Windmills	0	0	0	0	0	0	0
Garza		Total	16,075	9,893	9,257	8,301	7,382	6,989	6,709
Hale	Red	Ogallala Aquifer	3,499	829	0	0	0	0	0
Hale	Red	Stock Tanks and Windmills	1	1	1	1	1	1	1
Hale	Brazos	Ogallala Aquifer	374,974	348,301	302,704	206,807	127,551	98,721	89,136
Hale	Brazos	Ogallala (Roberts Co.)	1,476	2,854	2,482	2,482	2,482	2,250	2,250
Hale	Brazos	Stock Tanks and Windmills	324	331	340	349	358	368	379
Hale	Brazos	Lake Meredith (CRMWA)	2,805	1,427	1,799	1,799	1,799	1,631	1,631
Hale	Brazos	Reclaimed	5,477	5,477	5,477	5,477	5,477	5,477	5,477
Hale		Total	388,556	359,221	312,803	216,915	137,668	108,448	98,874

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Table 3-1 Continued

Counties	River Basin	Source	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Hockley	Brazos	Ogallala Aquifer	163,639	96,889	79,415	67,208	55,876	53,945	50,540
Hockley	Brazos	Ogallala (Roberts Co.)	1,116	1,116	1,116	1,116	1,116	688	688
Hockley	Brazos	Stock Tanks and Windmills	221	226	273	280	286	292	299
Hockley	Brazos	Lake Meredith (CRMWA)	2,120	2,120	2,120	2,120	2,120	2,120	2,120
Hockley	Brazos	Reclaimed	1,359	1,359	1,359	1,359	1,359	1,359	1,359
Hockley	Colorado	Ogallala Aquifer	20,274	12,761	10,678	8,807	8,186	7,686	7,689
Hockley	Colorado	Stock Tanks and Windmills	44	45	55	55	56	57	59
Hockley	Colorado	Reclaimed	162	162	162	162	162	162	162
Hockley		Total	188,935	114,679	95,178	81,107	69,160	66,309	62,915
Lamb	Brazos	Ogallala Aquifer	402,158	267,764	210,668	156,745	109,741	91,026	81,651
Lamb	Brazos	Stock Tanks and Windmills	472	491	510	531	552	575	599
Lamb	Brazos	Reclaimed	7,199	7,199	7,199	7,199	7,199	7,199	7,199
Lamb		Total	409,829	275,454	218,377	164,475	117,492	98,801	89,449
Lubbock	Brazos	Ogallala Aquifer	298,052	163,283	131,367	110,204	88,545	85,490	80,557
Lubbock	Brazos	Ogallala Aquifer (Bailey Co)	12,000	10,000	8,000	6,000	4,000	3,000	3,000
Lubbock	Brazos	Ogallala (Roberts Co.)	15,453	21,940	20,202	20,202	20,202	19,043	19,043
Lubbock	Brazos	Stock Tanks and Windmills	258	265	272	280	289	298	308
Lubbock	Brazos	Lake Meredith (CRMWA)	30,082	11,123	14,861	14,861	14,861	14,020	14,020
Lubbock	Brazos	Lake Alan Henry	0	21,960	21,960	21,960	21,960	21,960	21,960
Lubbock	Brazos	Reclaimed Lubbock-El Pr.	5,776	5,221	4,440	5,191	6,106	7,222	8,582
Lubbock	Brazos	Reclaimed Lubbock-Irrig.	7,958	9,166	0	0	0	0	0
Lubbock	Brazos	Reclaimed Other Mun & Ind	4,209	4,209	4,209	4,209	4,209	4,209	4,209
Lubbock		Total	373,788	247,167	205,311	182,907	160,171	155,242	151,679
Lynn	Brazos	Ogallala Aquifer	120,425	120,425	120,425	120,425	120,425	120,425	120,425
Lynn	Brazos	Edwards-Trinity (H-P Aqu)	4,944	4,160	3,580	2,802	2,335	2,065	2,065
Lynn	Brazos	Ogallala (Roberts Co.)	184	548	477	477	477	417	417
Lynn	Brazos	Stock Tanks and Windmills	128	132	136	139	144	149	153
Lynn	Brazos	Lake Meredith (CRMWA)	350	274	345	345	345	302	302
Lynn	Brazos	Reclaimed (Lubbock-Irrig)	6,496	6,496	0	0	0	0	0
Lynn	Brazos	Reclaimed Other Mun & Ind	346	346	346	346	346	346	346
Lynn	Colorado	Ogallala Aquifer	1,141	491	473	462	467	422	381
Lynn	Colorado	Ogallala (Roberts Co.)	91	91	91	91	91	61	61
Lynn	Colorado	Stock Tanks and Windmills	11	11	11	12	12	13	14
Lynn	Colorado	Lake Meredith (CRMWA)	173	173	173	173	173	173	173
Lynn		Total	134,290	133,148	126,057	125,272	124,815	124,372	124,336
Motley	Red	Ogallala Aquifer	10,200	5,717	5,565	5,411	5,254	5,115	4,991
Motley	Red	Seymour Aquifer	18,817	18,817	18,817	13,507	13,507	13,507	13,507
Motley	Red	Other Aquifers	239	234	224	207	187	174	166
Motley	Red	Stock Tanks and Windmills	625	636	647	659	671	684	698
Motley		Total	29,881	25,404	25,253	19,784	19,619	19,480	19,362
Parmer	Red	Ogallala Aquifer	135,705	76,545	26,066	19,901	36,235	37,658	35,109
Parmer	Red	Stock Tanks and Windmills	273	286	298	309	324	341	356
Parmer	Red	Reclaimed	2,486	2,486	2,486	2,486	2,486	2,486	2,486
Parmer	Brazos	Ogallala Aquifer	289,384	182,317	60,373	31,879	15,545	14,122	16,671

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Table 3-1 Continued

Counties	River Basin	Source	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Parmer	Brazos	Stock Tanks and Windmills	530	551	575	601	626	651	680
Parmer	Brazos	Reclaimed	401	401	401	401	401	401	401
Parmer		Total	430,779	264,596	92,219	57,607	57,657	57,709	57,763
Swisher	Red	Ogallala Aquifer	109,814	93,170	84,809	75,784	66,827	64,355	63,614
Swisher	Red	Dockum Aquifer	846	846	846	846	846	846	846
Swisher	Red	Stock Tanks and Windmills	421	435	475	493	512	531	551
Swisher	Red	Lake Mackenzie	417	0	0	0	0	0	0
Swisher	Brazos	Ogallala Aquifer	66,489	59,724	23,582	2,488	1,098	533	531
Swisher	Brazos	Stock Tanks and Windmills	168	167	141	139	136	133	132
Swisher	Brazos	Total	178,155	154,342	109,854	79,749	69,418	66,398	65,673
Terry	Brazos	Ogallala Aquifer	8,237	6,069	5,756	5,461	4,704	4,713	4,719
Terry	Brazos	Stock Tanks and Windmills	4	7	10	8	12	10	7
Terry	Colorado	Ogallala Aquifer	158,282	113,165	86,251	67,983	54,595	54,570	54,553
Terry	Colorado	Ogallala (Roberts Co.)	879	1,699	1,478	1,478	1,478	1,478	1,478
Terry	Colorado	Stock Tanks and Windmills	115	115	114	119	118	124	130
Terry	Colorado	Lake Meredith (CRMWA)	1,670	850	1,071	1,071	1,071	1,071	1,071
Terry		Total	169,187	121,904	94,681	76,121	61,979	61,966	61,958
Yoakum	Colorado	Ogallala Aquifer	133,881	103,958	99,734	95,204	91,342	88,062	85,269
Yoakum	Colorado	Stock Tanks and Windmills	214	218	273	278	282	288	293
Yoakum		Total	134,095	104,176	100,007	95,482	91,624	88,350	85,562
RIVER BASINS									
Canadian		Ogallala Aquifer	171	112	74	1	1	1	1
Canadian		Ogallala (Roberts Co.)	0	0	0	0	0	0	0
Canadian		Dockum Aquifer	0	0	0	0	0	0	0
Canadian		Seymour Aquifer	0	0	0	0	0	0	0
Canadian		Other Aquifers	0	0	0	0	0	0	0
Canadian		Stock Tanks and Windmills	220	281	317	326	336	344	353
Canadian		Lake Mackenzie	0	0	0	0	0	0	0
Canadian		White River Reservoir	0	0	0	0	0	0	0
Canadian		Lake Meredith (CRMWA)	0	0	0	0	0	0	0
Canadian		Reclaimed Lubbock-El Pr.	0	0	0	0	0	0	0
Canadian		Reclaimed Lubbock-Irrig.	0	0	0	0	0	0	0
Canadian		Reclaimed Other Mun & Ind	0	0	0	0	0	0	0
Canadian		Total	390	393	391	327	337	345	354

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Table 3-1 Continued

Counties	River Basin	Source	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
Red		Ogallala Aquifer	945,251	570,492	411,878	313,364	254,419	246,029	233,892
Red		Ogallala (Roberts Co.)	0	0	0	0	0	0	0
Red		Dockum Aquifer	1,876	1,666	1,524	8,448	8,522	8,548	8,548
Red		Seymour Aquifer	30,817	30,817	30,817	20,545	20,545	20,545	20,545
Red		Other Aquifers	354	343	320	301	282	265	257
Red		Stock Tanks and Windmills	5,100	5,227	5,442	5,645	5,863	6,095	6,335
Red		Lake Mackenzie	502	0	0	0	0	0	0
Red		White River Reservoir	0	0	0	0	0	0	0
Red		Lake Meredith (CRMWA)	0	0	0	0	0	0	0
Red		Reclaimed Lubbock-El Pr.	0	0	0	0	0	0	0
Red		Reclaimed Lubbock-Irrig.	0	0	0	0	0	0	0
Red		Reclaimed Other Mun & Ind	5,296	5,296	5,296	5,296	5,296	5,296	5,296
Red		Total	989,196	613,841	455,277	353,599	294,927	286,779	274,873
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Brazos		Ogallala Aquifer	2,620,312	1,838,970	1,482,356	1,163,654	880,144	777,733	737,591
Brazos		Ogallala (Roberts Co.)	18,229	26,458	24,277	24,277	24,277	22,398	22,398
Brazos		Dockum Aquifer	136	136	136	136	136	136	136
Brazos		Seymour Aquifer	4,831	4,831	4,831	3,332	3,332	3,332	3,332
Brazos		Edwards-Trinity (H-P Aqu)	4,944	4,160	3,580	2,802	2,335	2,065	2,065
Brazos		Stock Tanks and Windmills	4,088	4,210	4,446	4,577	4,716	4,854	5,003
Brazos		Lake Mackenzie	362	0	0	0	0	0	0
Brazos		White River Reservoir	2,003	1,999	1,947	1,463	979	495	8
Brazos		Lake Meredith (CRMWA)	35,357	15,250	19,431	19,431	19,431	18,379	18,379
Brazos		Lake Alan Henry	0	22,500	22,500	22,500	22,500	22,500	22,500
Brazos		Reclaimed Lubbock-El Pr.	5,776	5,221	4,440	5,191	6,106	7,222	8,582
Brazos		Reclaimed Lubbock-Irrig.	14,454	15,662	0	0	0	0	0
Brazos		Reclaimed Other Mun & Ind	25,146	25,146	25,146	25,146	25,146	25,146	25,146
Brazos		Total	2,735,638	1,964,542	1,593,090	1,272,508	989,102	884,260	845,140
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Colorado		Ogallala Aquifer	935,656	645,323	542,249	483,623	434,588	381,997	356,573
Colorado		Ogallala (Roberts Co.)	1,862	3,498	3,055	3,055	3,055	2,908	2,908
Colorado		Dockum Aquifer	0	0	0	0	0	0	0
Colorado		Seymour Aquifer	0	0	0	0	0	0	0
Colorado		Other Aquifers	0	0	0	0	0	0	0
Colorado		Stock Tanks and Windmills	918	936	1,045	1,068	1,086	1,113	1,144
Colorado		Lake Mackenzie	0	0	0	0	0	0	0
Colorado		White River Reservoir	0	0	0	0	0	0	0
Colorado		Lake Meredith (CRMWA)	3,537	1,877	2,320	2,320	2,320	2,236	2,236
Colorado		Reclaimed Lubbock-El Pr.	0	0	0	0	0	0	0
Colorado		Reclaimed Lubbock-Irrig.	0	0	0	0	0	0	0
Colorado		Reclaimed Other Mun & Ind	189	189	189	189	189	189	189
		Total	942,163	651,822	548,858	490,255	441,238	388,443	363,050

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Table 3-1 Concluded

Counties	River Basin	Source	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
LLANO ESTACADO REGION ---- TOTALS									
Region		Ogallala Aquifer	4,501,390	3,054,897	2,436,556	1,960,641	1,569,152	1,405,760	1,328,057
Region		Ogallala (Roberts Co.)	20,091	29,956	27,332	27,332	27,332	25,306	25,306
Region		Dockum Aquifer	2,012	1,802	1,660	8,584	8,658	8,684	8,684
Region		Seymour Aquifer	35,648	35,648	35,648	23,877	23,877	23,877	23,877
Region		Other Aquifers	5,298	4,503	3,900	3,103	2,617	2,330	2,322
Region		Stock Tanks and Windmills	10,326	10,653	11,250	11,616	12,000	12,406	12,835
Region		Lake Mackenzie	864	0	0	0	0	0	0
Region		White River Reservoir	2,003	1,999	1,947	1,463	979	495	8
Region		Lake Meredith (CRMWA)	38,894	17,127	21,751	21,751	21,751	20,615	20,615
Region		Lake Alan Henry	0	22,500	22,500	22,500	22,500	22,500	22,500
Region		Reclaimed Lubbock-El Pr.	5,776	5,221	4,440	5,191	6,106	7,222	8,582
Region		Reclaimed Lubbock-Irrig.	14,454	15,662	0	0	0	0	0
Region		Reclaimed Other Mun & Ind	30,631	30,631	30,631	30,631	30,631	30,631	30,631
Region		Total	4,667,387	3,230,598	2,597,615	2,116,689	1,725,603	1,559,826	1,483,417
LLANO ESTACADO REGION --- Percent of Total									
Region		Ogallala Aquifer	96.44%	94.56%	93.80%	92.63%	90.93%	90.12%	89.53%
Region		Ogallala (Roberts Co.)	0.43%	0.93%	1.05%	1.29%	1.58%	1.62%	1.71%
Region		Dockum Aquifer	0.04%	0.06%	0.06%	0.41%	0.50%	0.56%	0.59%
Region		Seymour Aquifer	0.76%	1.10%	1.37%	1.13%	1.38%	1.53%	1.61%
Region		Other Aquifers	0.11%	0.14%	0.15%	0.15%	0.15%	0.15%	0.16%
Region		Stock Tanks and Windmills	0.22%	0.33%	0.43%	0.55%	0.70%	0.80%	0.87%
Region		Lake Mackenzie	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Region		White River Reservoir	0.04%	0.06%	0.07%	0.07%	0.06%	0.03%	0.00%
Region		Lake Meredith (CRMWA)	0.83%	0.53%	0.84%	1.03%	1.26%	1.32%	1.39%
Region		Lake Alan Henry	0.00%	0.70%	0.87%	1.06%	1.30%	1.44%	1.52%
Region		Reclaimed Lubbock-El Pr.	0.12%	0.16%	0.17%	0.25%	0.35%	0.46%	0.58%
Region		Reclaimed Lubbock-Irrig.	0.31%	0.48%	0.00%	0.00%	0.00%	0.00%	0.00%
Region		Reclaimed Other Mun & Ind	0.66%	0.95%	1.18%	1.45%	1.78%	1.96%	2.06%
Region		Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

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Figure 3-1. Projected Water Supply for the Llano Estacado Water Planning Region

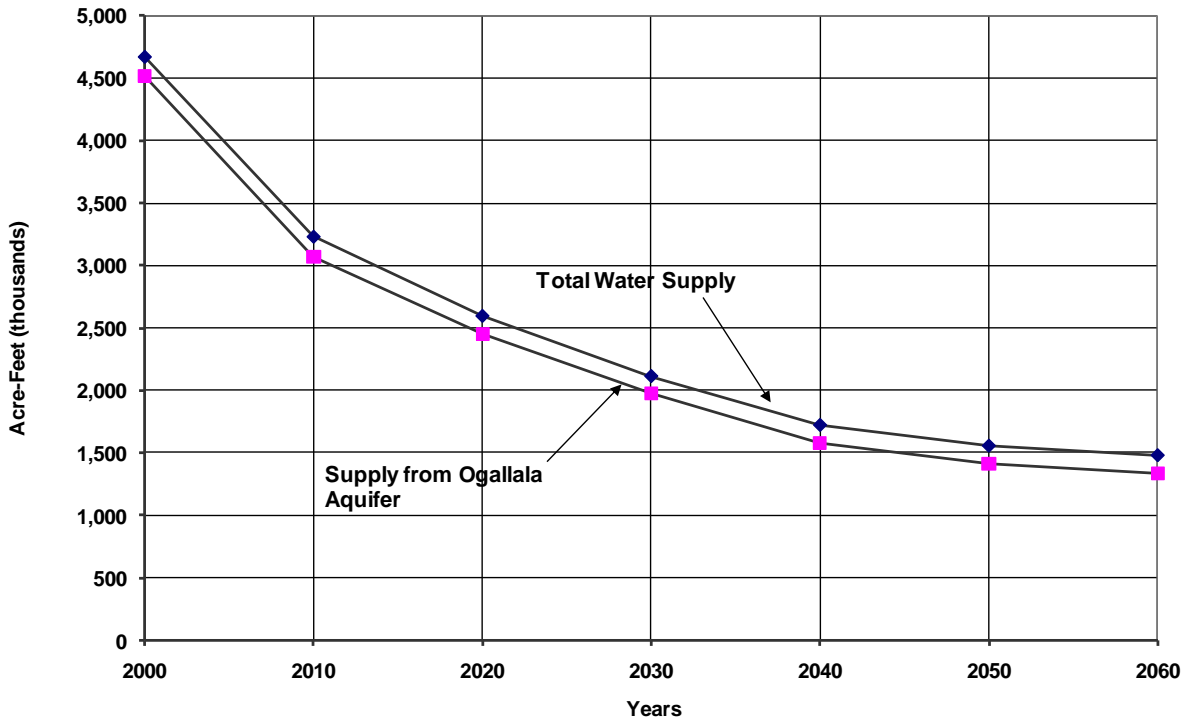


Figure 3-1. Projected Water Supply for the Llano Estacado Water Planning Region

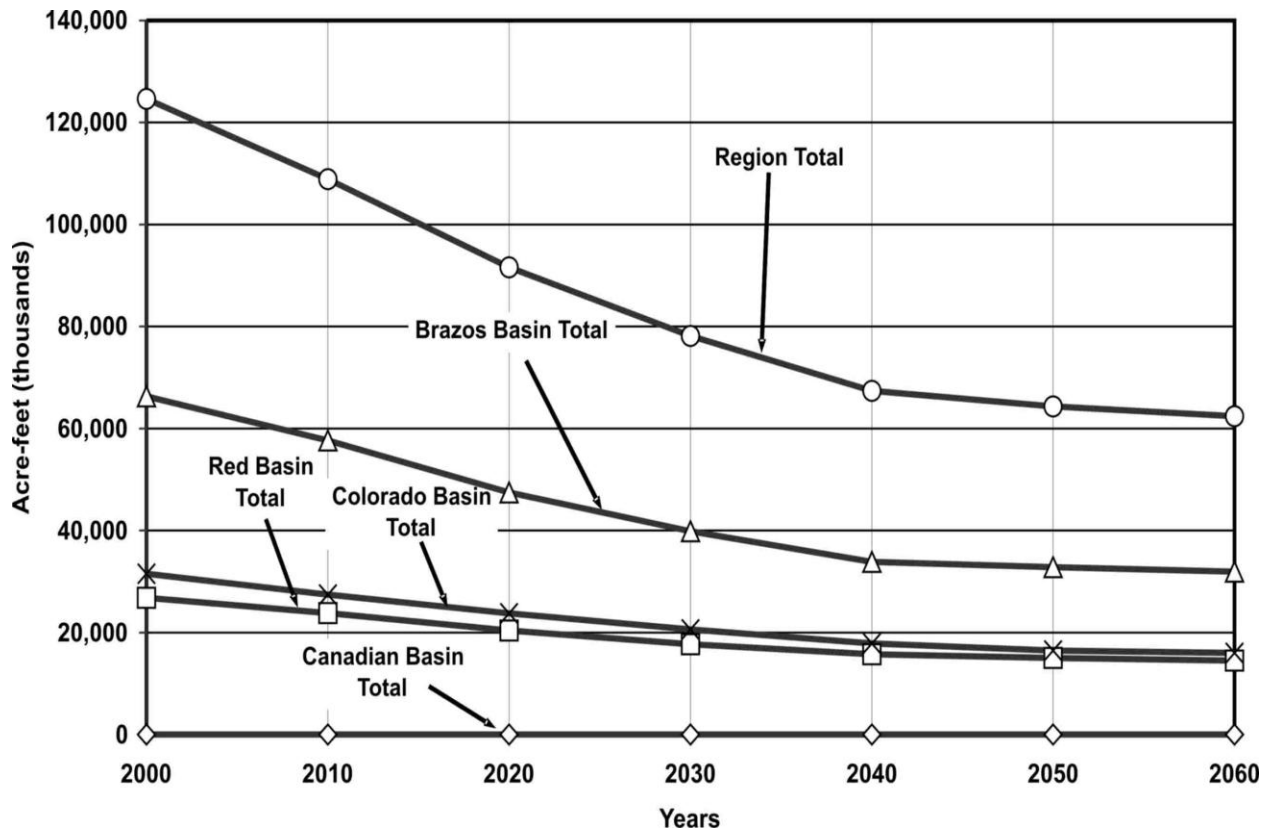
The estimated quantity of water in storage in the Ogallala Aquifer in 2000 was 124,653,395 acft and is projected to decline to 62,418,860 acft in 2060 (i.e., in 2060, it is projected that the quantity of water remaining in storage will be about 50.1 percent of the quantity estimated to have been in storage in 2000) (Table 3-2 and Figure 3-2). However, the estimated quantities of water remaining in storage in 2060 as shown in Table 3-2 varies widely among the counties of the region. For example, for 10 of the counties of the region (Bailey, Castro, Cochran, Deaf Smith, Gaines, Hale, Lamb, Motley, Parmer, and Yoakum) show that less than 40 percent of estimated quantities of water in storage in year 2000 are projected to be remaining in storage in 2060 (Table 3-2). For 7 counties (Briscoe, Crosby, Dickens, Floyd, Hockley, Lubbock, Swisher, and Terry), between 56 percent and about 82 percent of estimated

quantities of water in storage in year 2000 are projected to remain in storage in 2060. The results for these 17 counties appear to be consistent with expectations of declining quantities of water in storage in view of the water level declines, as shown in long term water level measurements of monitoring wells in the region. However, the results for 4 counties (Dawson, Garza, and Lynn) show that more than 95 percent of estimated quantities of water in storage in year 2000 are projected to be remaining in storage in 2060. In the case of Dawson County, the quantity of water projected to remain in storage remains constant at 7,202,322 acft (Table 3-2). A similar result is shown for Garza County, with projected quantity of water in storage remaining constant at 643,700 acft (Table 3-2), and in the case of Lynn County, projected quantities of water in storage remain in the range of 3,645,979 acft/yr to 3,655,103 (Table 3-2). It appears that the calculations of quantities of water remaining in storage for Dawson, Garza, and Lynn Counties, as provided by the Southern Ogallala GAM may be the result of errors in the locations of irrigation demands, in relation to locations of areas of the counties having water in storage and therefore should be checked before making further use of the GAM model for developing water supply information for regional water planning purposes.

It is reiterated that the quantity of water available from the Ogallala and the quantity remaining in storage at each of the projection dates was calculated using the TWDB GAM, and is based upon the capability of the aquifer to yield water to the wells presently in place. If the number of water wells is increased in future years, the Model Runs could result in larger quantities of water available per year in the early years of the projections, but due to the fact that pumpage is much greater than recharge, water availability would be lower in later years. The calculated quantity that could be pumped for use by water user groups for each county-basin area for each projected year is less than the projected water demands for the same area (i.e., water supplies available annually are projected to be less than projected water demands) (Table 3-1).

**Table 3-2
Projected Quantity of Water in Storage
Individual Counties with River Basin Summaries
LlanoEstacadoRegion**

County	2000 (ac-ft)	2010 (ac-ft)	2020 (ac-ft)	2030 (ac-ft)	2040 (ac-ft)	2050 (ac-ft)	2060 (ac-ft)	Percent Remaining (2000--2060)
Bailey	4,272,200	3,380,925	2,546,788	1,769,102	1,229,855	1,216,106	1,212,373	28.38%
Briscoe	2,164,466	2,036,351	1,870,525	1,756,762	1,680,434	1,650,541	1,632,676	75.43%
Castro	8,801,770	6,895,847	4,238,764	2,254,998	1,223,544	1,054,373	897,274	10.19%
Cochran	2,578,704	1,834,111	1,308,992	813,743	347,354	81,708	37,705	1.46%
Crosby	10,949,015	10,612,852	10,085,108	9,980,291	9,152,440	9,038,236	8,946,553	81.71%
Dawson	7,266,792	7,202,322	7,202,322	7,202,322	7,202,322	7,202,322	7,202,322	99.11%
Deaf Smith	7,851,767	6,647,546	5,230,982	4,163,213	3,383,867	3,152,925	3,000,017	38.21%
Dickens	1,119,192	1,037,297	1,032,409	1,027,698	862,252	817,846	813,589	72.69%
Floyd	13,012,008	11,832,107	11,397,458	10,489,267	9,764,296	9,587,136	9,409,491	72.31%
Gaines	12,495,883	10,232,860	7,998,429	6,120,700	4,493,051	3,708,105	3,651,389	29.22%
Garza	662,851	643,700	643,700	643,700	643,700	643,700	643,700	97.11%
Hale	9,867,018	8,192,891	5,591,955	3,651,208	2,463,726	2,164,064	1,886,697	19.12%
Hockley	5,480,511	4,993,208	4,432,736	3,965,426	3,615,247	3,591,108	3,533,107	64.47%
Lamb	8,246,693	6,944,619	5,155,582	3,861,385	2,953,511	2,743,521	2,533,373	30.72%
Lubbock	7,439,809	6,632,577	5,611,743	4,952,167	4,159,806	4,141,607	4,114,001	55.30%
Lynn	3,786,579	3,645,979	3,655,103	3,655,103	3,655,103	3,655,103	3,655,103	96.53%
Motley	355,295	282,644	231,003	180,893	132,340	85,257	39,482	11.11%
Parmer	1,775,591	1,228,925	732,604	512,575	436,291	416,838	401,421	22.61%
Swisher	7,568,857	6,816,315	5,837,065	5,156,220	4,622,929	4,392,133	4,184,417	55.28%
Terry	4,576,781	4,161,424	3,801,304	3,563,138	3,428,883	3,520,915	3,619,055	79.07%
Yoakum	4,381,613	3,620,371	3,017,014	2,457,580	1,939,772	1,457,384	1,005,116	22.94%
Region	124,653,395	108,874,870	91,621,586	78,177,491	67,390,724	64,320,927	62,418,860	50.07%
BASIN TOTALS								
Canadian	2,599	1,798	894	684	684	684	684	26.32%
Red	26,802,969	23,822,702	20,386,139	17,699,494	15,718,619	15,035,381	14,476,096	54.01%
Brazos	66,322,545	57,639,248	47,478,393	39,860,073	33,829,805	32,839,469	31,939,798	48.16%
Colorado	31,525,282	27,411,121	23,756,159	20,617,240	17,841,616	16,445,393	16,002,283	50.76%
Total	124,653,395	108,874,870	91,621,586	78,177,491	67,390,724	64,320,927	62,418,860	50.07%
Percent of Total in each Basin								
Canadian	0.0021%	0.0017%	0.0010%	0.0009%	0.0010%	0.0011%	0.0011%	-
Red	21.5020%	21.8808%	22.2504%	22.6401%	23.3246%	23.3756%	23.1919%	-
Brazos	53.2056%	52.9408%	51.8201%	50.9866%	50.1995%	51.0557%	51.1701%	-
Colorado	25.2904%	25.1767%	25.9286%	26.3723%	26.4749%	25.5677%	25.6369%	-
Total	100.0000%	100.0000%	100.0000%	100.0000%	100.0000%	100.0000%	100.0000%	-
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**Figure 3-2. Projected Quantity of Water in Storage—Ogallala Aquifer
Llano Estacado Water Planning Region**