Section 2
Population and Water Demand
Executive Summary

In the 2006 Llano Estacado Regional Water Plan, there was no provision for water for the operation of ethanol plants, since there were no such plants located in the region at the time the regional water plan was being developed, and there were no projections that such plants would be located in the region during the 50-year planning period. However, in Deaf Smith, Hale, and Hockley Counties of the Llano Estacado Water Planning Region, as of 2008, three ethanol plants of 110 million gallons production capacity per year and one plant of 50 million gallons per year capacity have been constructed and either are in operation or will be in operation within a few months. The combined water requirements of these four plants are about 3.5 million gallons per day, or 3,920 acre-feet per year.

In the 2006 Regional Water Plan, dairy cattle numbers in Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, Lubbock, and Terry Counties were about 14,900 head in year 2000, and were projected at 87,018 in 2010, reaching a maximum of 159,133 in 2020. However, during the period of 2005 through 2007, the dairy industry of Bailey, Castro, Deaf Smith, Hale, Lamb, and Parmer Counties has increased significantly. The number of dairies has grown from 37 to 59, and the estimated number of dairy cattle has increased from about 55,000 in 2005 to 130,498 head in 2008, with milk production increasing from 4.14 million pounds per day in 2005 to 9.00 million pounds per day in March 2008. The projected number of head of dairy cattle in the eight-county area has been revised to 155,750 in 2010, 188,544 in 2020, and 280,714 head in 2060.

Drinking water demands for dairy cattle and dairy milking parlor sanitation were based upon 48 gallons per cow per day instead of the 65 gallons per cow per day of the 2006 Regional Water Plan. The revised projections show an increase from quantities of the 2006 Regional Water Plan of about 6,256 acre-feet per year in 2010, lower quantities of water demand for these purposes for the period of 2017 through 2033 (1,449 acre-feet per year less in 2020), and 15,093 acre-feet per year more in 2060 than was projected for the 2006 Regional Water Plan.

The increased dairy production is projected to result in a larger population due to more dairy workers, resulting in an increased municipal water demand of 466 acre-feet per year in 2010, an increased demand of 182 acre-feet per year in 2020, and for 2060 an increased municipal demand of 769 acre-feet per year.

The increased irrigation water requirements for feed production for the revised dairy projections, in comparison to irrigation requirements for traditional cropping patterns are 16,938 acre-feet per year in 2010, 20,504 acre-feet per year in 2020, 25,019 acre-feet per year in 2040, and 30,528 acre-feet per year in 2060.

The total increased water demand for ethanol production, dairies, dairy population and dairy feed production is 23,362 acre-feet per year in 2010, 30,166 acre-feet per year in 2040, and 38,723 acre-feet per year in 2060.

Introduction

During the months immediately following the completion and adoption of the 2006 Llano Estacado Regional Water Plan the Llano Estacado Regional Water Planning Group (LERWPG) became informed about the appearance of the ethanol industry, a completely new economic enterprise within the Llano Estacado Water Planning Region (Region O), and an unexpected increase in the dairy sector. Since there had not been any consideration given in the 2006 Regional Water Plan for water for ethanol production, and since that which had been given to the water needs of the dairy sector is clearly inadequate for this rapidly growing sector, it was decided to compute: (1) estimates of the growth of these two water using-sectors, (2) the effects of this growth upon the size of the population, and (3) the quantities of additional water needed by these sectors, the associated population, and related support sectors of the ethanol and dairy sectors. The estimates are presented below.

2.1 The Ethanol Sector

In the 2006 Regional Water Plan, water for ethanol production was not included, since there were no ethanol plants located in the region. As of the date of this report, three 110 million gallons per year and one 50 million gallons per year production capacity ethanol distilling plants have been constructed, and either are in operation, or will be in operation within a few months. Two of the 110 million gallons per year plants are located at Hereford in Deaf Smith County, one 110 million gallons per year plant is located near Levelland in Hockley County, and the 50 million gallons per year plant is located near Plainview in Hale County. According to an ethanol industry representative, water requirements for these ethanol plants are as follows: the 110 million gallons per year plants need 1.0 MGD (million gallons per day) and the 50 million gallons per year plant needs 0.5 MGD of fresh water for operation.[1] Thus, the water demands for these plants amount to an annual increased in manufacturing water demands in Deaf Smith County of 2,240 acre-feet per year, in Hockley County of 1,120 acre-feet per year, and in Hale County of 560 acre-feet per year, bringing the total increased manufacturing demand in the study area to 3,920 acre-feet per year.

[1] Personal interview with Mr. Tim Snyder.

With respect to effects of the ethanol plants upon demands for feedstock (corn, grain sorghum, and other crops) that would affect demand for irrigation water, representatives of the ethanol industry have indicated that the plants located at Hereford will be importing 100 percent of the grain (corn) to be used in the production process, and will not be obtaining grain feedstock from local sources.[2] The plants located at Levelland and Plainview are reported to be using a mixture of imported corn and locally produced grain sorghum, depending upon availability of grain sorghum. However, the industry is not expected to increase the number of ethanol plants in the foreseeable future, since the railway capacity to transport grain to the area will have been reached when the present plants are in operation, and railway industry representatives have informed the industry that there are no plans to increase rail capacity for these purposes. Thus, the estimated increased demand for manufacturing water is projected at 3,920 acre-feet per year through 2060, with 2,240 acre-feet per year in Deaf Smith county, 1,120 acre-feet per year in Hockley County, and 560 acre-feet per year in Hale County. The increased demand for grain for ethanol production is projected to result in a shift of irrigation water use from other crops into grain production, but since the available supplies of irrigation water are already being used; i.e.; there are irrigation water shortages in the counties affected, there is no net projected increase in irrigation water demand for these purposes.

With respect to labor, ethanol industry representatives indicated that each plant has 60 full time jobs, of which one-half or 30 will be new arrivals from outside the region and one-half, or 30 will be local hires. Thus, it is estimated that the new ethanol plants will have no appreciable effect upon the populations of the counties in which they are located, since recent population information from the Texas State Data Center indicates that the populations of the study area counties have continued to decrease in larger numbers annually than are represented by the employment potentials of the ethanol plants.

[2] Even though corn is to be imported to the region for ethanol production, the increased national demand for corn for ethanol production has driven the price of corn up, and Region O irrigation farmers are responding by increasing the production of corn by transferring acreages of other irrigated crops into corn production.

2.2 The Dairy Sector

2.2.1 Revised Estimates and Projections of Numbers of Dairy Cattle, and Dairy Water Demand

In the 2006 Llano Estacado Regional Water Plan, the numbers of dairy cattle in the Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, Lubbock, and Terry County area were 14,899 in year 2000 and were projected to be 87,018 in 2010, growing to 159,133 in 2020, and remaining at the 2020 level through 2060 (Table 2.2-1 and Figure 2.2-1).[3] Projected water requirements for dairy uses (drinking water for milking and dry cows and replacement heifers, plus sanitation at milking parlors) were projected to increase from 1,085 acre-feet per year in 2000 to 6,336 acre-feet per year in 2010, to 11,587 acre-feet per year in 2020, and remain at that level through 2060 (Table2.2-1). However, due to the trend of increased milk production, as reported to the Milk Market Administrator, the numbers of dairy cattle and the quantities of water demand of the 2006 Regional Water Plan are too low (Table 2.2-2). For example, in January of 2005, the total number of dairies in the six county area for which data are available (Bailey, Castro, Deaf Smith, Hale, Lamb, and Parmer) was 37, with average daily milk production of 4.14 million pounds (Table 2.2-2). By January of 2006, there were 44 dairies, with average daily milk production of 5.52 million pounds, and by March of 2008, there were 59 dairies with average daily milk production reported at 9.01 million pounds (Table 2.2-2). During the period from January 2005 through March 2008, the number of dairies increased from 37 to 59, or about 60 percent, while average daily milk production increased from 4.14 million pounds to 9.01 million pounds, or about 117 percent. Production in Bailey County increased by 117 percent, production in Castro County increased by 86 percent, production in Deaf Smith County increased by 238 percent, with Hale County having a 23 percent increase, Lamb County increased by 41 percent, and Parmer County increased by 315 percent. Due to the extremely rapid growth milk production since year 2005, it is clear that the numbers of head of dairy cattle and the projected dairy sector water demands of the 2006 Regional Water Plan are too low and will be revised in this study, as is explained below.

[3] The Scope of Work for this report has been expanded to include Lubbock and Terry Counties, since the Texas Association of Dairymen provided information for these counties along with information for Bailey, Castro, Deaf Smith, Hale, Lamb, and Parmer Counties.

Table 2.2-1.
Projected Number of Head of Dairy Cattle and Projected Water Requirements for Dairy Cattle as Included in the 2006 Llano Estacado Regional Water Plan

No.*	County	Total in 1990 No. Head	Total in 2000 No. Head	Projections 2010 No. Head	2020 No. Head	2030 No. Head	2040 No. Head	2050 No. Head	2060 No. Head
1	Bailey	3,000	3,200	15,095	26,991	26,991	26,991	26,991	26,991
3	Castro	1,238	2,000	15,326	28,651	28,651	28,651	28,651	28,651
7	Deaf Smith	1,869	500	15,529	30,558	30,558	30,558	30,558	30,558
12	Hale	0	400	5,374	10,347	10,347	10,347	10,347	10,347
14	Lamb	1,214	8,400	21,309	34,218	34,218	34,218	34,218	34,218
18	Parmer	1,047	400	13,292	26,183	26,183	26,183	26,183	26,183
15	Lubbock	0	0	0	0	0	0	0	0
20	Terry	0	0	1,092	2,185	2,185	2,185	2,185	2,185
	Total	8,368	14,899	87,018	159,133	159,133	159,133	159,133	159,133

		Quantity of Water Demand for Dairy Uses (Drinking Water for Cattle and Milking Parlors)**							
No.*	County	1990 (acft)	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
1	Bailey	252	233	1,099	1,965	1,965	1,965	1,965	1,965
3	Castro	104	146	1,116	2,086	2,086	2,086	2,086	2,086
7	Deaf Smith	157	36	1,131	2,225	2,225	2,225	2,225	2,225
12	Hale	0	29	391	753	753	753	753	753
14	Lamb	102	612	1,552	2,491	2,491	2,491	2,491	2,491
18	Parmer	88	29	968	1,906	1,906	1,906	1,906	1,906
15	Lubbock	0	0	0	0	0	0	0	0
20	Terry	0	0	80	159	159	159	159	159
	Total	703	1,085	6,336	11,587	11,587	11,587	11,587	11,587

* County number as listed in 2006 Regional Water Plan.
* * Calculated at 65 gallons per head per day. <><><><>

Since there are no official reports of numbers of dairy cattle nor quantities of water used by dairies, it is necessary to estimate both the numbers of head of dairy cattle and quantities of water used by dairies.[4] The Texas Association of Dairymen, in cooperation with Dr. Ellen Jordan (Professor and Extension Dairy Specialist, Texas A&M Center, Dallas, Texas), through the LERWPG Dairy Committee provided information about dairies in the study area counties of the Llano Estacado Water

[4] In October of 2007, the number of head of dairy cattle permitted by the Texas Commission on Environmental Quality (TCEQ) for the six county area of Bailey, Castro, Deaf Smith, Hale, Lamb, and Parmer was approximately 1,026,630, and according to representatives of TCEQ has been increasing at approximately one (1) percent per month. However, representatives of the Texas Association of Dairymen have advised the LERWPG that many of these permits are based upon speculation, and that market conditions will not support the implementation of dairies to the extent of the TCEQ permitted numbers.

Table 2.2-2.
Reported Number of Dairies and Average Daily Milk Production for the Months of January 2005, January 2006, January 2007, and March 2008

No.*	County	January-05		January-06		January-07		March-08	
		Number of Dairies	Pounds of Milk Per Day	Number of Dairies	Pounds of Milk Per Day	Number of Dairies	Pounds of Milk Per Day	Number of Dairies	Pounds of Milk Per Day
1	Bailey	7	481,903	8	816,287	8	842,490	9	1,097,860
3	Castro	8	875,653	8	942,755	10	1,118,569	10	1,630,348
7	Deaf Smith	5	539,745	8	1,176,377	11	1,337,021	13	1,826,393
12	Hale	4	792,021	5	894,767	6	802,108	5	973,863
14	Lamb	8	922,295	9	1,001,092	9	1,061,223	9	1,300,829
18	Parmer	5	524,298	6	690,714	10	1,099,465	13	2,178,341
15	Lubbock	NA	NA	NA	NA	NA	NA	NA	NA
20	Terry	NA	NA	NA	NA	NA	NA	NA	NA
	Total	37	4,135,915	44	5,521,992	54	6,260,876	59	9,007,633

* County number as listed in 2006 Regional Water Plan.
Source: Milk Market Administrator, AMS, Dairy Programs, US Department of Agriculture, Carrollton, Texas, December, 2007.
NA Means not available. <><><><>

Planning Region (Appendix).[5] The estimated number of dairy cows in 2008 in the eight county area is 130,498, and is projected to be 155, 750 in 2010, 188,544 in 2020, 230,060 in 2040, and 280,716 in 2060 (Table 2.2-3 and Figure 2.2-1). Castro, Deaf Smith, and Parmer Counties have the largest numbers per county in 2008 at 23,082, 26,800, and 30,491 head, respectively, and are projected to grow to 53,152, 50,621, and 56,577 head, respectively by 2060 (Table 2.2-3). Bailey, Hale, and Lamb Counties have numbers in 2008 of 15,218, 13,531, and 17,876 head, respectively, growing to 47,822, 26,576, and 38,710 head, respectively in 2060 (Table 2.2-3). Lubbock and Terry Counties have numbers in the 1,500 to 2,000 head range in 2008, growing to 3,110 and 4,146 head in 2060 (Table 2.2-3 and Figure 2.2-1).

Based upon 2008 data, the projected numbers of dairy cows for the eight county area is 68,732 head greater for 2010 than was included in the 2006 Regional Water Plan, is 29,411 read greater in 2020, 70,926 head greater in 2040, and is 121,581 head greater in 2060 (Table 2.2-4 and figure 2.2-1). The projected dairy cow numbers are greater for

[5] Letter of April 28, 2008 from Mr. John Cowan, Executive Director, Texas Association of Dairymen to the LERWPG Dairy Committee, whose membership included Dr. Melanie Barnes, Ch., Dr. Don Ethridge, Mr. Bob Josserand, and Mr. Ben Weinheimer. The information provided included numbers of dairy cattle, projected rates of growth of dairy cattle numbers, and water requirements for drinking, sanitation, and forage production for the dairy industry.

Table 2.2-3.
Projected Numbers of Dairy Cows and Replacement Heifers for Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, Lubbock, and Terry Counties (2008 Revised)

No.*	County	Estimated Total Dairy Cattle 2008 (head)[1]	Projected Numbers of Dairy Cattle[1]					
			2010 (head)	2020 (head)	2030 (head)	2040 (head)	2050 (head)	2060 (head)
1	Bailey	15,218	24,700	32,120	35,480	39,193	43,293	47,822
3	Castro	23,082	27,450	35,700	39,435	43,561	48,118	53,152
7	Deaf Smith	26,800	29,000	34,000	37,557	41,486	45,827	50,621
12	Hale	13,531	15,900	17,850	19,718	21,780	24,059	26,576
14	Lamb	17,876	24,000	26,000	28,720	31,725	35,044	38,710
18	Parmer	30,491	31,000	38,000	41,976	46,367	51,218	56,577
15	Lubbock	1,500	1,600	2,089	2,308	2,549	2,816	3,110
20	Terry	2,000	2,100	2,785	3,076	3,398	3,754	4,146
	Total	130,498	155,750	188,544	208,270	230,059	254,129	280,714

* County number as listed in 2006 Regional Water Plan.

[1] Data from Federal Milk Market Administration and industry Cooperative Marketing Analysis, with projections of growth from 2008 to 2010 at 9.24 percent per year, from 2010 to 2020 at 1.9 percent per year, and from 2020 to 2060 at 1.00 percent per year. <><><><>

Figure 2.2-1: Projected Numbers of Head of Dairy Cattle

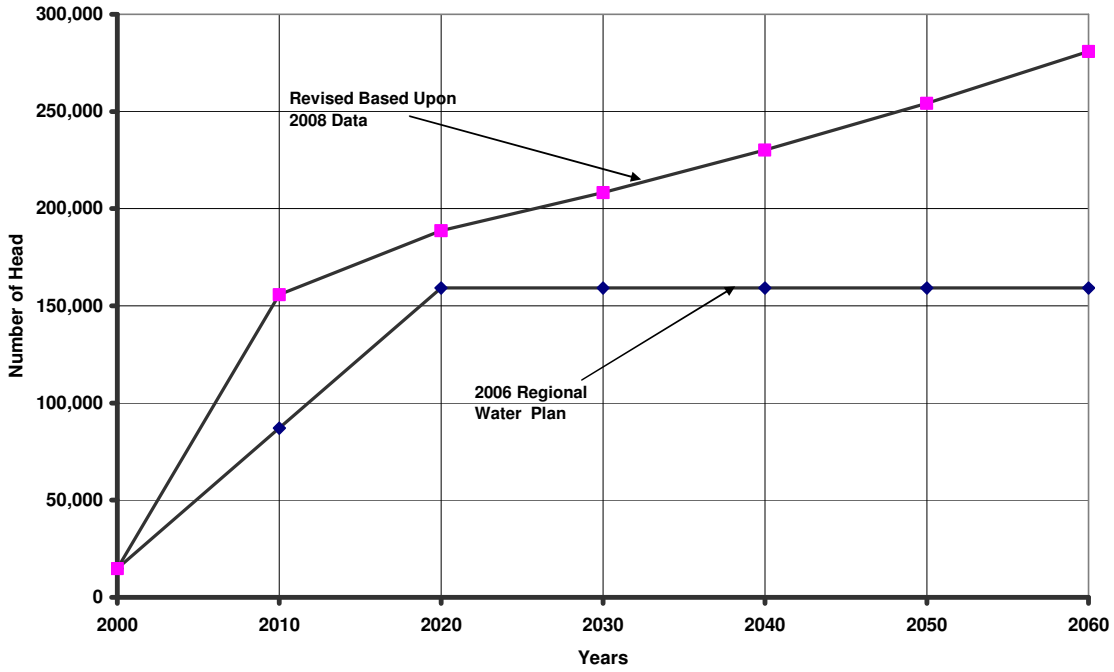

Table 2.2-4.
Projected Increased Numbers of Dairy Cattle (Cows and Replacement Heifers) for Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, Lubbock, and Terry Counties (Differences between 2008 Revised and 2006 Regional Water Plan Projections)

No.*	County	Increased Projections of Dairy Cattle over 2006 Regional Water Plan					
		2010 (head)	2020 (head)	2030 (head)	2040 (head)	2050 (head)	2060 (head)
1	Bailey	9,605	5,129	8,489	12,202	16,302	20,831
3	Castro	12,124	7,049	10,784	14,910	19,467	24,501
7	Deaf Smith	13,471	3,442	6,999	10,928	15,269	20,063
12	Hale	10,526	7,503	9,371	11,433	13,712	16,229
14	Lamb	2,691	-8,218	-5,498	-2,493	826	4,492
18	Parmer	17,708	11,817	15,793	20,184	25,035	30,394
15	Lubbock	1,600	2,089	2,308	2,549	2,816	3,110
20	Terry	1,008	600	891	1,213	1,569	1,961
	Total	68,732	29,411	49,137	70,926	94,996	121,581

* County number as listed in 2006 Regional Water Plan. <><><><>

each projection date for each county except for Lamb County for 2020, 2030, and 2040 (Table 2.2-4).

Water demands for dairies (drinking water for dairy cattle plus water for sanitation) for the eight-county area are projected to increase from 7,016 acre-feet per

Table 2.2-5.
Projected Water Demands for Dairies of Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, Lubbock, and Terry Counties (2008 Revised)

No.*	County	Estimated Total Dairy Water Use 2008 (acft)	Projected Dairy Water Demands[1]					
			2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
1	Bailey	818	1,328	1,727	1,908	2,107	2,328	2,571
3	Castro	1,241	1,476	1,919	2,120	2,342	2,587	2,858
7	Deaf Smith	1,441	1,559	1,828	2,019	2,231	2,464	2,722
12	Hale	728	855	960	1,060	1,171	1,294	1,429
14	Lamb	961	1,290	1,398	1,544	1,706	1,884	2,081
18	Parmer	1,639	1,667	2,043	2,257	2,493	2,754	3,042
15	Lubbock	81	86	112	124	137	151	167
20	Terry	108	113	150	165	183	202	223
	Total	7,016	8,374	10,137	11,198	12,370	13,664	15,093

* County number as listed in 2006 Regional Water Plan.

[1] Calculated at 48 gallons per head per day. Source of data is Texas Dairy Association; see footnote 5.

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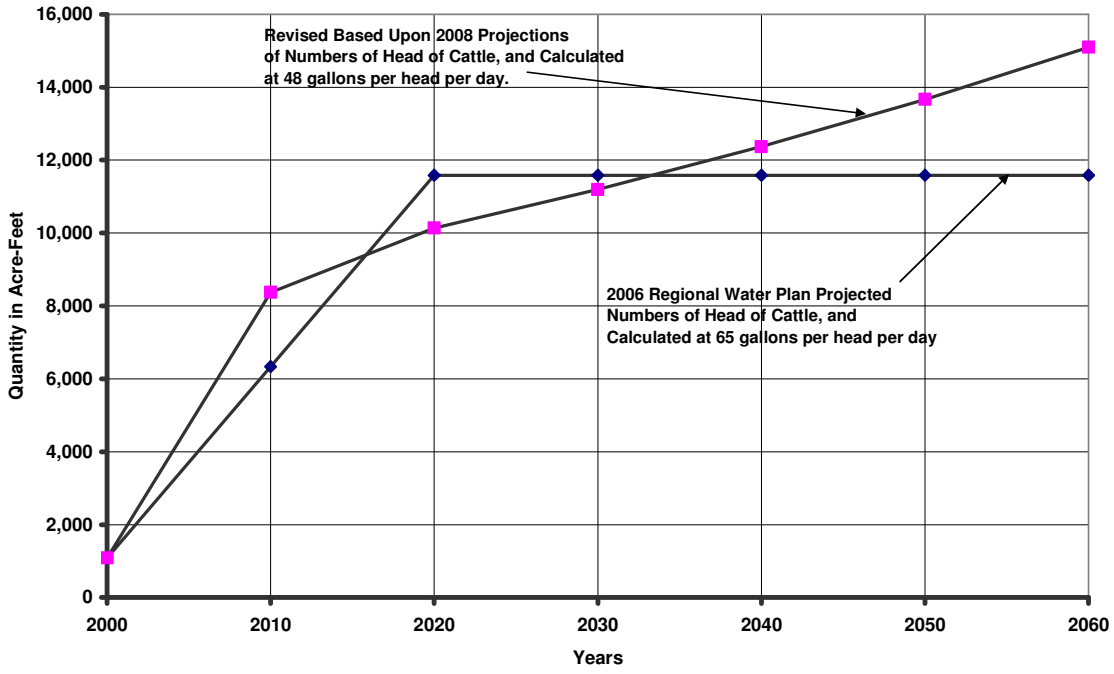
year in 2008, to 8,374 acre-feet per year in 2010, to 10,137 acre-feet per year in 2020, to 12,370 acre-feet per year in 2040, and to 15,093 acre-feet per year in 2060 (Table 2.2-5 and Figure 2.2-2). In comparison to the 2006 Regional Water Plan projections of dairy water demand, the 2008 updated projections are based upon a larger number of head of dairy cattle in all counties of the study area except Lamb County, as mentioned above,

Figure 2.2-2: Projected Dairy Water Demand



the quantity of water use per cow per day for the revised 2008 projections is 48 gallons per head per day, while the 2006 Regional Water Plan dairy water demand projections were calculated at 65 gallons per head per day. Thus, the results shown in figure 2.2-2 show higher water demands from year 2000 through about 2017, lower total demands from 2017 through about 2033, and higher demands thereafter (Figure 2.2-2 and Table 2.2-6); i.e.; the increased numbers of head of cattle do not completely offset the lowering of the per head per day of water demand from 65 gallons to 48 gallons, as is shown in Figure 2.2-2 and Table 2.2-6. Thus, the total projected water demand for dairies in 2010 is 2,038 acre-feet per year greater than was included in the 2006 Regional Water Plan, but is 1,449 acre-feet per year less in 2020, 388 acre-feet per year less in 2030, and 3,507

acre-feet per year greater in 2060 (Table 2.2-6 and Figure 2.2-2). The reader can see the differences for each county in Table 2.2-6.

Table 2.2-6.
Differences between 2008 Revised Water Demand Projections and 2006 Regional Water Plan Projections of Dairy Water Demand for Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, Lubbock, and Terry Counties

			Difference Between 2008 Revised Dairy Water Demand Projections and Projections of Dairy Water Demands of the 2006 Regional Water Plan					
No.*	County		2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
1	Bailey		229	-238	-58	142	363	606
3	Castro		360	-167	34	256	501	772
7	Deaf Smith		429	-397	-206	6	239	497
12	Hale		464	206	307	418	540	676
14	Lamb		-261	-1,093	-947	-786	-607	-410
18	Parmer		699	137	351	587	847	1,136
15	Lubbock		86	112	124	137	151	167
20	Terry		33	-9	6	24	43	64
	Total		2,038	-1,449	-388	783	2,077	3,507

* County number as listed in 2006 Regional Water Plan. <><><><>

2.2.2 Estimates and Projections of Numbers of Dairy Workers and Dairy Worker Associated Population

Projections of population resulting from the projected growth of dairies of the area are based upon the following estimates and assumptions:

- Projected number of dairy workers is calculated at one worker per 100 projected head of dairy cattle; and
- Projected population associated with dairy workers is based upon 3.5 persons per household.

The estimated number of dairy workers in the study area in 2000 referenced in the 2006 Regional Water Plan is 149, and was projected at 870 in 2010, and at 1,591 workers in 2020 through 2060 (Table 2.2-7). For the revised projections of the increased dairy production, the estimated number of dairy workers in 2008 is 1,305, is projected at 1,558 in 2010, 1,885 in 2020, 2,301 in 2040, and 2,807 in 2060 (Table 2.2-7 and Figure 2.2-3). The increased projections of dairy production over the level included in the 2006 regional Water Plan

Table 2.2-7.
Comparison of Projected Number of Dairy Workers of 2006 Regional Water Plan with Projected Number of Dairy Workers for Increased Dairy Production (2008 Revisions) for Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, Lubbock and Terry Counties

No.*	County		2000 (number)	2006 Regional Water Plan Projected Number of Dairy Workers 2010 (number)	2020 (number)	2030 (number)	2040 (number)	2050 (number)	2060 (number)
1	Bailey		32	151	270	270	270	270	270
3	Castro		20	153	287	287	287	287	287
7	Deaf Smith		5	155	306	306	306	306	306
12	Hale		4	54	103	103	103	103	103
14	Lamb		84	213	342	342	342	342	342
18	Parmer		4	133	262	262	262	262	262
15	Lubbock		0	0	0	0	0	0	0
20	Terry		0	11	22	22	22	22	22
	Total		149	870	1,591	1,591	1,591	1,591	1,591

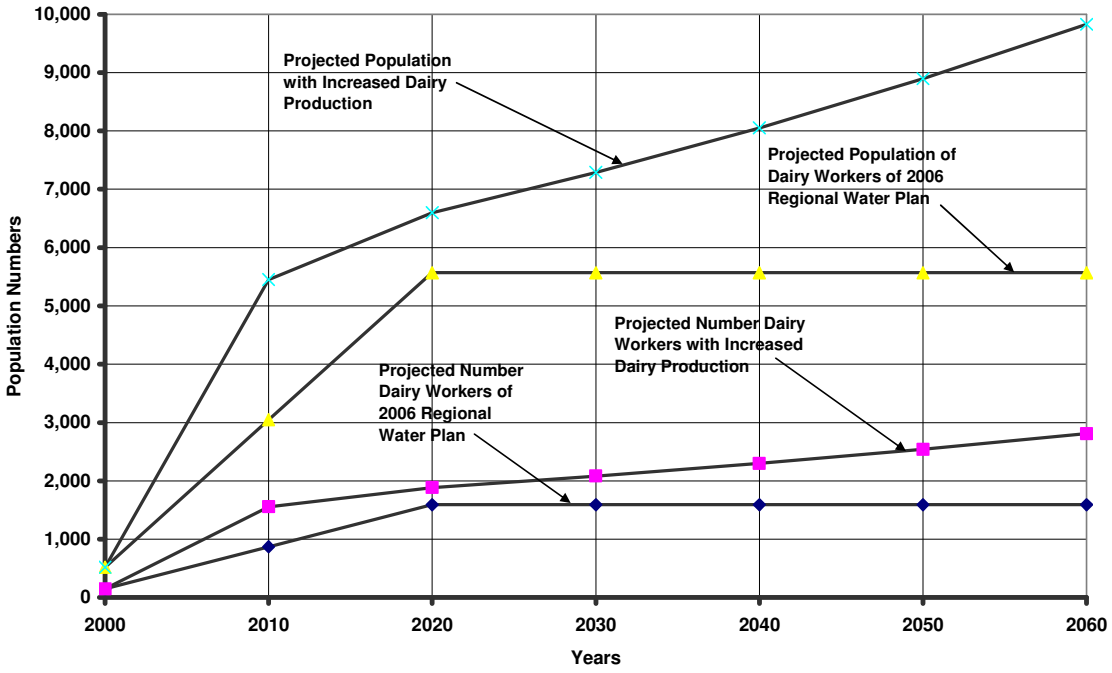
No.*	County		2008	2008 Revised Projected Total Number of Dairy Workers 2010 (number)	2020 (number)	2030 (number)	2040 (number)	2050 (number)	2060 (number)
1	Bailey		152	247	321	355	392	433	478
3	Castro		231	275	357	394	436	481	532
7	Deaf Smith		268	290	340	376	415	458	506
12	Hale		135	159	179	197	218	241	266
14	Lamb		179	240	260	287	317	350	387
18	Parmer		305	310	380	420	464	512	566
15	Lubbock		15	16	21	23	25	28	31
20	Terry		20	21	28	31	34	38	41
	Total		1,305	1,558	1,885	2,083	2,301	2,541	2,807

No.*	County		Projected Increased in Number of Dairy Workers above 2006 Regional Water Plan 2010 (number)	2020 (number)	2030 (number)	2040 (number)	2050 (number)	2060 (number)
1	Bailey		96	51	85	122	163	208
3	Castro		121	70	108	149	195	245
7	Deaf Smith		135	34	70	109	153	201
12	Hale		105	75	94	114	137	162
14	Lamb		27	-82	-55	-25	8	45
18	Parmer		177	118	158	202	250	304
15	Lubbock		16	21	23	25	28	31
20	Terry		10	6	9	12	16	19
	Total		687	294	491	709	950	1,216

* County number as listed in 2006 Regional Water Plan. <><><><>

results in an increase in projected numbers of dairy workers of 687 in 2010, 294 in 2020, 2,310 in 2040, and 2,807 in 2060 (Table 2.2-7 and Figure 2.2-3).

Figure 2.2-3: Projected Numbers of Dairy Workers and Associated Population



At 3.5 persons per household, the size of the dairy worker and dairy worker associated population of the 2006 Regional Water Plan was estimated at 3,046 in 2010, and 5,570 from 2020 to 2060 (Table 2.2-8 and Figure 2.2-3). For the revised projections of dairy production, the dairy workers and associated population was projected at 5,451 in 2010, 6,559 in 2020, 8,052 in 2040, and 9,828 in 2060 (Table 2.2-8 and Figure 2.2-3). The increased dairy production is projected to result in an increase in dairy worker and associated population in the eight county area of 2,405 in 2010, 1,029 in 2020, 2,482 in 2040, and 4,255 in 2060 Table 2.2-8 and Figure 2.2-3).

Table 2.2-8
Comparison of Projected Number of Dairy Workers and Associated Population of 2006 Regional Water Plan with Projected Number of Dairy Workers and Associated Population for Increased Dairy Production (2008 Revisions) for Bailey, Castro, Deaf Smith, Hale, Lamb, Parmer, Lubbock and Terry Counties

No.*	County		2000 (number)	2006 Regional Water Plan Projected Dairy Workers and Associated Population 2010 (number)	2020 (number)	2030 (number)	2040 (number)	2050 (number)	2060 (number)
1	Bailey		112	528	945	945	945	945	945
3	Castro		70	536	1,003	1,003	1,003	1,003	1,003
7	Deaf Smith		17	544	1,070	1,070	1,070	1,070	1,070
12	Hale		14	188	362	362	362	362	362
14	Lamb		294	746	1,198	1,198	1,198	1,198	1,198
18	Parmer		14	465	916	916	916	916	916
15	Lubbock		0	0	0	0	0	0	0
20	Terry		0	39	77	77	77	77	77
	Total		521	3,046	5,570	5,570	5,570	5,570	5,570

No.*	County			2008 Revised Projected Population of Dairy Workers Associated Population 2010 (number)	2020 (number)	2030 (number)	2040 (number)	2050 (number)	2060 (number)
1	Bailey			865	1,124	1,242	1,372	1,515	1,674
3	Castro			961	1,250	1,380	1,525	1,684	1,860
7	Deaf Smith			1,015	1,190	1,314	1,452	1,604	1,772
12	Hale			557	625	690	762	842	930
14	Lamb			840	910	1,005	1,110	1,227	1,355
18	Parmer			1,085	1,330	1,469	1,623	1,793	1,980
15	Lubbock			56	73	81	89	99	109
20	Terry			74	97	108	119	131	145
	Total			5,451	6,599	7,289	8,052	8,895	9,825

No.*	County			Increased Projected Dairy Worker and Associated Population above 2006 Regional Water Plan 2010 (number)	2020 (number)	2030 (number)	2040 (number)	2050 (number)	2060 (number)
1	Bailey			336	180	297	427	571	729
3	Castro			424	247	377	522	681	858
7	Deaf Smith			471	120	245	382	534	702
12	Hale			368	263	328	400	480	568
14	Lamb			94	-288	-192	-87	29	157
18	Parmer			620	414	553	706	876	1,064
15	Lubbock			56	73	81	89	99	109
20	Terry			35	20	31	42	54	68
	Total			2,405	1,029	1,719	2,482	3,324	4,255

* County number as listed in 2006 Regional Water Plan.

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Projections of municipal water demand for the population of dairy workers and the associated population was based upon projected per capita municipal water demands of the 2006 regional Water Plan of each county, as shown in Table 2.2-9. Municipal water demand for dairy workers and the associated population for the eight county area was projected at 1,082 acre-feet per year in 2010, with municipal water demand for the eight county area projected at 1,277 acre-feet per year in 2020, 1,497 acre-feet per year in 2040, and 1,814 acre-feet per year in 2060 (Table 2.2-10 and Figure 2.2-4).

Table 2.2-9.
Projected Per Capita Municipal Water Demand for Projected Population of Dairy Workers and Associated Population of Study Counties

No.*	County	Projected Per Capita Municipal Water Use, with Water Conservation (2006 Regional Water Plan)						
		2008 (gpcd)	2010 (gpcd)	2020 (gpcd)	2030 (gpcd)	2040 (gpcd)	2050 (gpcd)	2060 (gpcd)
1	Bailey	174	173	170	167	164	163	163
3	Castro	175	174	171	168	165	164	164
7	Deaf Smith	192	190	182	176	172	170	170
12	Hale	153	151	148	145	142	141	141
14	Lamb	202	199	196	193	190	189	189
18	Parmer	165	164	160	157	154	153	153
15	Lubbock	207	205	202	199	196	195	195
20	Terry	209	208	205	202	199	198	198
	Total	188	186	182	179	177	176	176

* County number as listed in 2006 Regional Water Plan. <><><><>

Table 2.2-10.
Comparisons of 2008 Revised Projections of Municipal Water Demand of Dairy Worker Associated Populations to 2006 Regional Water Plan Projections of Municipal Water Demand of Dairy Worker Associated Populations of Study Counties

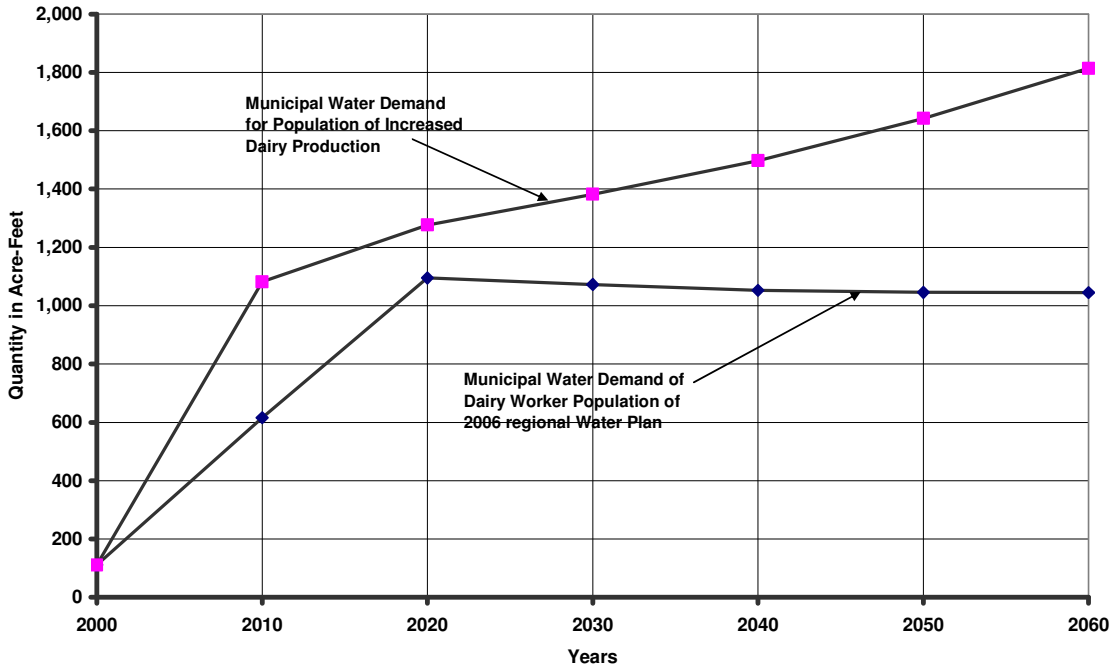
No.*	County		2006 Regional Water Plan Projected Municipal Water Demand of Dairy Workers and Associated Population						
			2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
1	Bailey		22	102	180	177	174	173	173
3	Castro		14	104	192	188	185	184	184
7	Deaf Smith		4	116	218	211	206	204	203
12	Hale		2	32	60	59	58	57	57
14	Lamb		67	167	263	259	255	254	254
18	Parmer		3	85	165	161	158	157	157
15	Lubbock		0	0	0	0	0	0	0
20	Terry		0	9	18	17	17	17	17
	Total		111	616	1,095	1,073	1,053	1,045	1,045

No.*	County		2008 Revised Projected Municipal Water Demand of Dairy Workers and Associated Population						
			2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
1	Bailey		22	168	214	232	252	277	306
3	Castro		14	187	239	259	281	309	341
7	Deaf Smith		4	216	243	260	279	305	337
12	Hale		2	94	104	112	121	133	147
14	Lamb		67	188	200	218	237	260	287
18	Parmer		3	199	239	259	280	308	340
15	Lubbock		0	13	17	18	20	22	24
20	Terry		0	17	22	24	26	29	32
	Total		111	1,082	1,277	1,382	1,497	1,642	1,814

No.*	County		Increased Projected Municipal Water Demand of Dairy Workers and Associated Population over 2006 Regional Water Plan					
			2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
1	Bailey		65	34	56	78	104	133
3	Castro		83	47	71	96	125	157
7	Deaf Smith		101	25	48	74	102	134
12	Hale		62	44	53	64	76	90
14	Lamb		21	-63	-42	-19	6	33
18	Parmer		114	74	97	122	150	183
15	Lubbock		13	17	18	20	22	24
20	Terry		8	5	7	9	12	15
	Total		466	182	309	444	597	769

* County number as listed in 2006 Regional Water Plan. <><><><>

Figure 2.2-4: Projected Municipal Water Demand of Dairy Worker Population



The increased dairy production over the levels of the 2006 Regional Water Plan results in an increase of municipal water demand in the eight-county area of 466 acre-feet per year in 2010, 182 acre-feet per year in 2020, 444 acre-feet per year in 2040, and 769 acre-feet per year in 2060 (Table 2.2-10 and Figure 2.2-4).

2.2.3 Projections of Increased Irrigation Water Demand to Produce Feed Crops for Dairies Above Traditional Cropping Patterns

Crop production to provide feed for dairies results in some changes from traditional irrigation production, particularly to grow silage for nearby dairies, in comparison to producing grain or cotton for more distant markets. The increased irrigation water requirements for feed production for the revised dairy projections, in comparison to irrigation requirements for traditional cropping patterns are 16,938 acre-feet per year in 2010, 20,504 acre-feet per year in 2020, 25,019 acre-feet per year in 2040, and 30,528 acre-feet per year in 2060 (Table 2.2-11).[6] The projected increases are shown in Table

[6] The Texas Association of Dairymen, in cooperation with Dr. Ellen Jordan, professor and Extension dairy specialist, Texas A&M Center, Dallas, Texas.

2.2-11 for each of the 12 counties, and are distributed in the same proportions as the increased numbers of dairy cattle are distributed among the counties (See Table 2.2-3), with about 17 percent in Bailey County, 18 percent in each of Castro and Deaf Smith Counties, 9 percent in Hale County, 14 per cent in Lamb county, 20 percent in Parmer County, 1 percent in Lubbock County and about 1.5 percent in Terry County.

Table 2.2-11.
Projected Increased Irrigation Water Demand for Increased Dairy Production Above Irrigation Water Demand Projections of 2006 Regional Water Plan

No.*	County			Projected Increased Irrigation Water Demands to Produce Feed Crops for Dairies Above Traditional Cropping Patterns					
				2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
1	Bailey			2,686	3,493	3,858	4,262	4,708	5,201
3	Castro			2,985	3,882	4,289	4,737	5,233	5,780
7	Deaf Smith			3,154	3,698	4,084	4,512	4,984	5,505
12	Hale			1,729	1,941	2,144	2,369	2,616	2,890
14	Lamb			2,610	2,828	3,123	3,450	3,811	4,210
18	Parmer			3,371	4,133	4,565	5,042	5,570	6,153
15	Lubbock			174	227	251	277	306	338
20	Terry			228	303	335	370	408	451
	Total			16,938	20,504	22,649	25,019	27,637	30,528

* County number as listed in 2006 Regional Water Plan. <><><><>

2.2.4 Projections of Total Increased Water Demand for Ethanol and Dairy Sectors of Llano Estacado Water Planning Region (Region O)

In Sections 2.2.1, 2.2.2, and 2.2.3 above, projections have been made of water demands for ethanol and dairy production activity levels that were not included in the 2006 Llano Estacado Regional Water Plan. These projections are summarized in Table 2.2-12, together with the total of ethanol, dairy, dairy worker population, and dairy feed production increased water demand projections for the Llano Estacado Water Planning Region, with projected water demand expressed in quantities greater than was included in the 2006 Regional Water Plan (Table 2.2-12). For ethanol, the quantity is 3,920 acre-feet per year, beginning in 2010 and continuing through 2060. For dairy cattle and milking parlor sanitation the quantity is 2,038 acre-feet per year greater in 2010 than was included in the 2006 regional Water Plan, 1,449 acre-feet per year less in 2020, 783

Table 2.2-12.
Projected Water Demand for Ethanol and Increased Dairy Production Above Water Demand Projections of 2006 Regional Water Plan

No.*	County			Projected Increased Water Demands Llano Estacado Water Planning Region (Region O)					
				2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
	Ethanol Plants								
7	Deaf Smith			2,240	2,240	2,240	2,240	2,240	2,240
12	Hale			560	560	560	560	560	560
13	Hockley			1,120	1,120	1,120	1,120	1,120	1,120
	Total			3,920	3,920	3,920	3,920	3,920	3,920
	Dairies								
1	Bailey			229	-238	-58	142	363	606
3	Castro			360	-167	34	256	501	772
7	Deaf Smith			429	-397	-206	6	239	497
12	Hale			464	206	307	418	540	676
14	Lamb			-261	-1,093	-947	-786	-607	-410
18	Parmer			699	137	351	587	847	1,136
15	Lubbock			86	112	124	137	151	167
20	Terry			33	-9	6	24	43	64
	Total			2,038	-1,449	-388	783	2,077	3,507
	Dairy Worker Population								
1	Bailey			65	34	56	78	104	133
3	Castro			83	47	71	96	125	157
7	Deaf Smith			101	25	48	74	102	134
12	Hale			62	44	53	64	76	90
14	Lamb			21	-63	-42	-19	6	33
18	Parmer			114	74	97	122	150	183
15	Lubbock			13	17	18	20	22	24
20	Terry			8	5	7	9	12	15
	Total			466	182	309	444	597	769
	Dairy Feed Production								
1	Bailey			2,686	3,493	3,858	4,262	4,708	5,201
3	Castro			2,985	3,882	4,289	4,737	5,233	5,780
7	Deaf Smith			3,154	3,698	4,084	4,512	4,984	5,505
12	Hale			1,729	1,941	2,144	2,369	2,616	2,890
14	Lamb			2,610	2,828	3,123	3,450	3,811	4,210
18	Parmer			3,371	4,133	4,565	5,042	5,570	6,153
15	Lubbock			174	227	251	277	306	338
20	Terry			228	303	335	370	408	451
	Total			16,938	20,504	22,649	25,019	27,637	30,528

Continued Next Page

* County number as listed in 2006 Regional Water Plan.

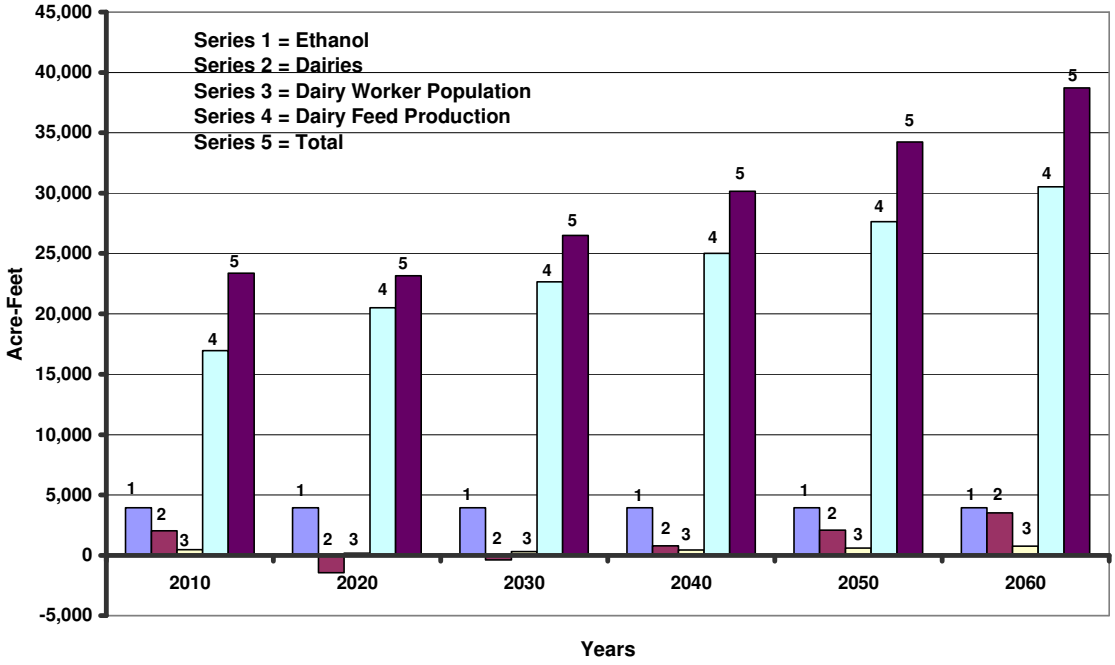
acre-feet greater in 2040, and is 3,507 acre-feet greater in 2060 (Table 2.2-12 and Figure 2.2-5). For dairy worker population, the projected increase in quantity of municipal

Table 2.2-12: Continued

No.*	County			Projected Increased Water Demands Llano Estacado Water Planning Region (Region O) 2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)	2060 (acft)
	Total Increased Water Demand								
1	Bailey			2,980	3,289	3,856	4,483	5,175	5,940
3	Castro			3,428	3,763	4,394	5,090	5,859	6,709
7	Deaf Smith			5,923	5,565	6,167	6,831	7,565	8,375
12	Hale			2,815	2,751	3,064	3,410	3,792	4,215
13	Hockley			1,120	1,120	1,120	1,120	1,120	1,120
14	Lamb			2,370	1,671	2,134	2,646	3,210	3,833
18	Parmer			4,184	4,343	5,013	5,751	6,568	7,471
15	Lubbock			273	356	393	434	479	529
20	Terry			270	298	348	402	463	530
	Total			23,362	23,157	26,490	30,166	34,231	38,723
	Percent of Total Increase								
	Ethanol			16.78%	16.93%	14.80%	12.99%	11.45%	10.12%
	Dairies			8.73%	-6.26%	-1.47%	2.60%	6.07%	9.06%
	Dairy Worker Population			2.00%	0.79%	1.17%	1.47%	1.74%	1.98%
	Dairy Feed Production			72.50%	88.54%	85.50%	82.94%	80.74%	78.84%
	Total			100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

* County number as listed in 2006 Regional Water Plan. <><><><>

Figure 2.2-5: Projected Increased Water Demand -- Region O



water demand is 466 acre-feet per year in 2010, 444 acre-feet in 2040, and 769 acre-feet per year in 2060 (Table 2.2-12 and Figure 2.2-5). For dairy feed production, the projected increased irrigation water demand is 16,938 acre-feet per year in 2010, 25,019 acre-feet per year in 2040, and 30,528 acre-feet per year in 2060 (Table 2.2-12 and Figure 2.2-5). The total increased water demand for ethanol production, dairies, dairy population and dairy feed production is 23,362 acre-feet per year in 2010, of which 16.7 percent is for ethanol production, 8.7 percent is for dairies, 2.0 percent is for dairy worker population, and 72.5 percent is for dairy feed production (Table 2.2-12 and Figure 2.2-5). The total is 30,166 acre-feet per year in 2040, and 38,723 acre-feet per year in 2060, of which ethanol production is 10.1 percent, dairies are 9.1 percent, dairy worker population is 1.98 percent, and dairy feed production is 78.8 percent (Table 2.2-12 and Figure 2.2-5).