Appendix B

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

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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.

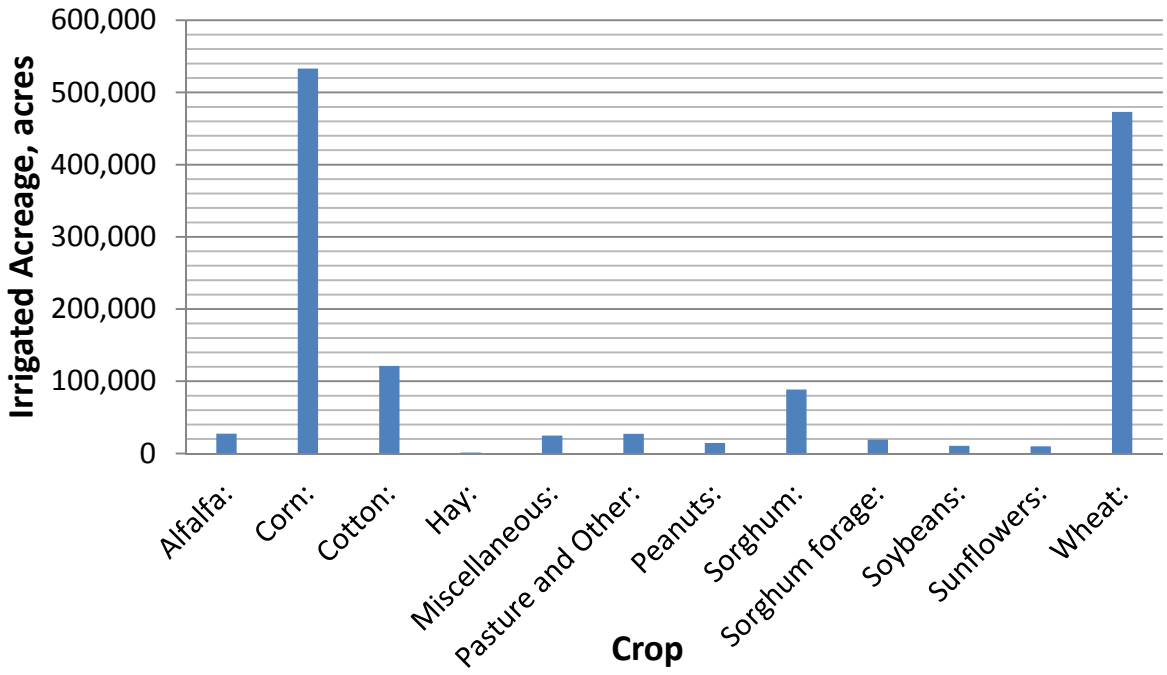

Figure 1. Region A 2016 RWP irrigated acreage by crop in 2020.

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**

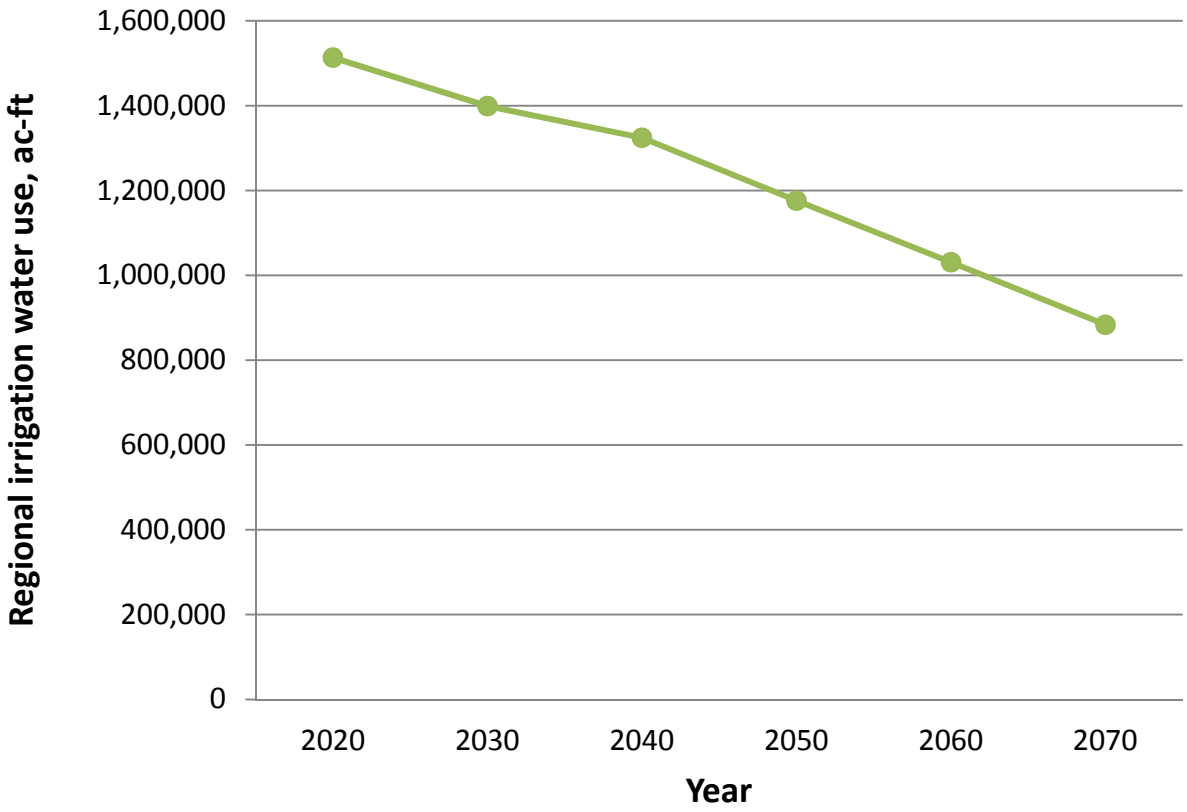

Figure 2. Region A 2016 RWP estimated regional irrigation water demand for selected years, ac-ft.

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.

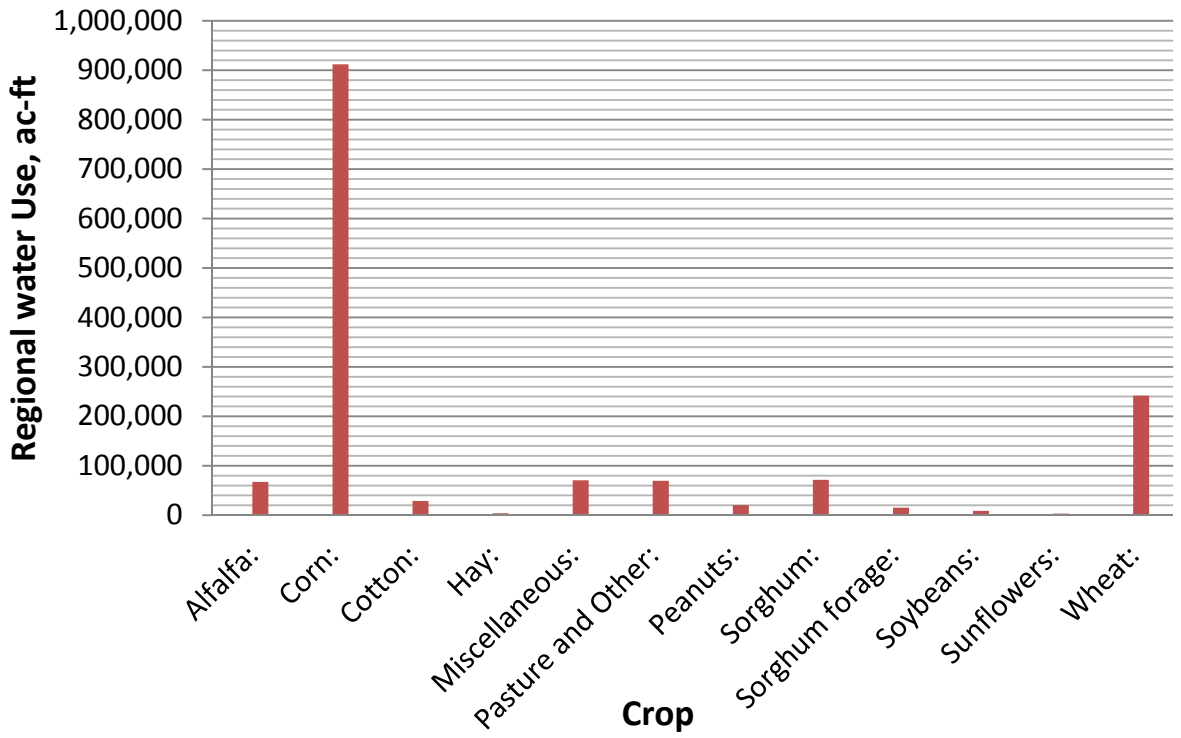

Figure 3. Region A 2016 RWP regional water use by crop in 2020.

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.

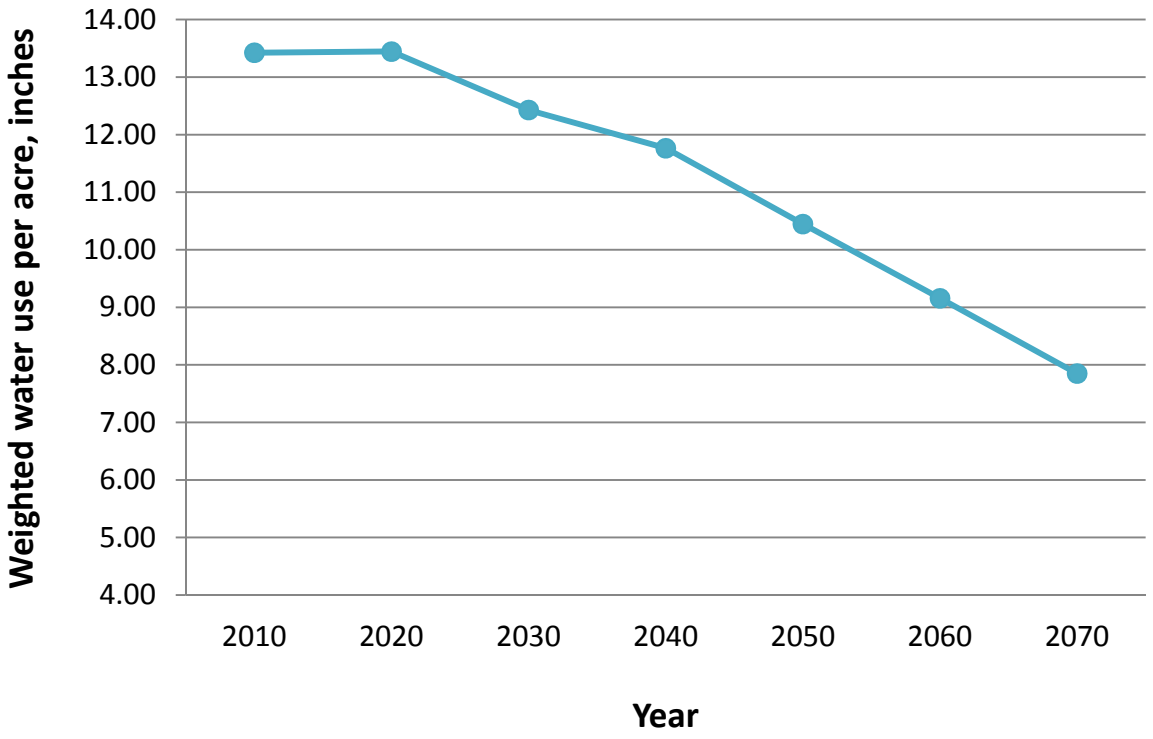

Figure 4. Region A 2016 RWP weighted (by crop) irrigation water use per acre.

Region A 2011 RWP and 2016 RWP Irrigation Water Use Comparison

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.

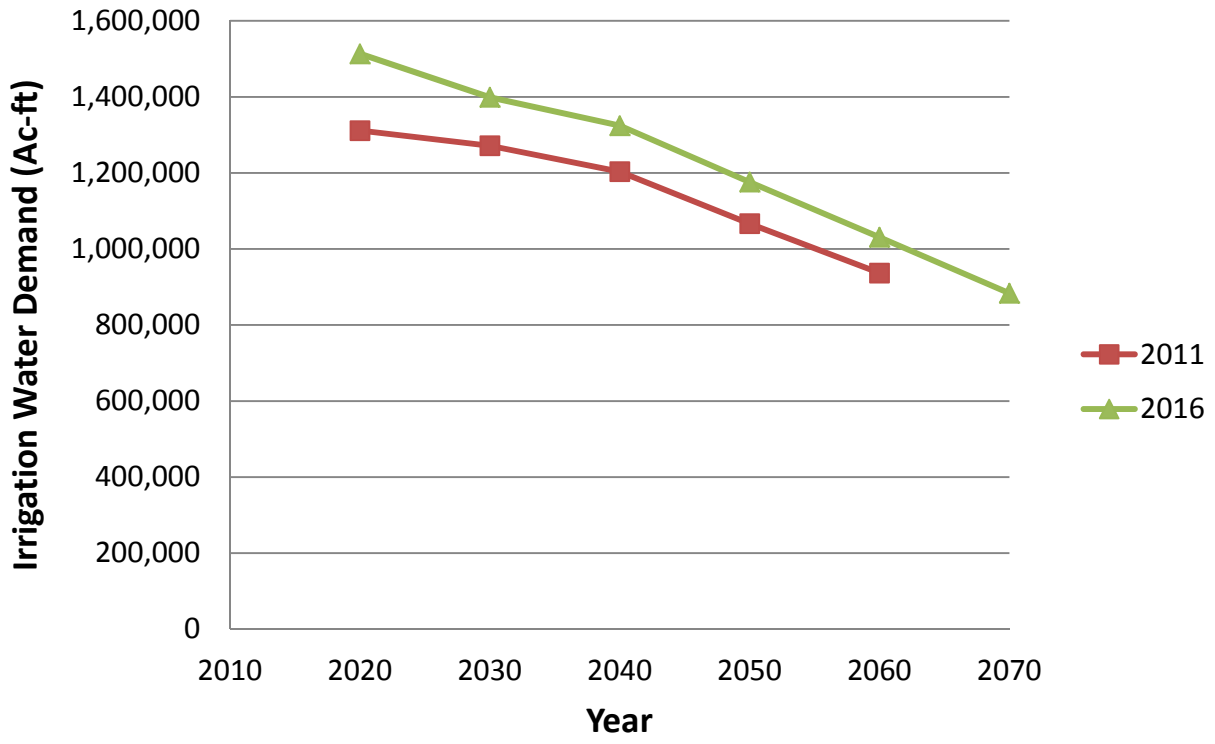

Figure 5. Region A comparison of estimated irrigation demand between 2011 RWP and 2016 RWP for selected years.

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

Livestock Projected Water Use

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**

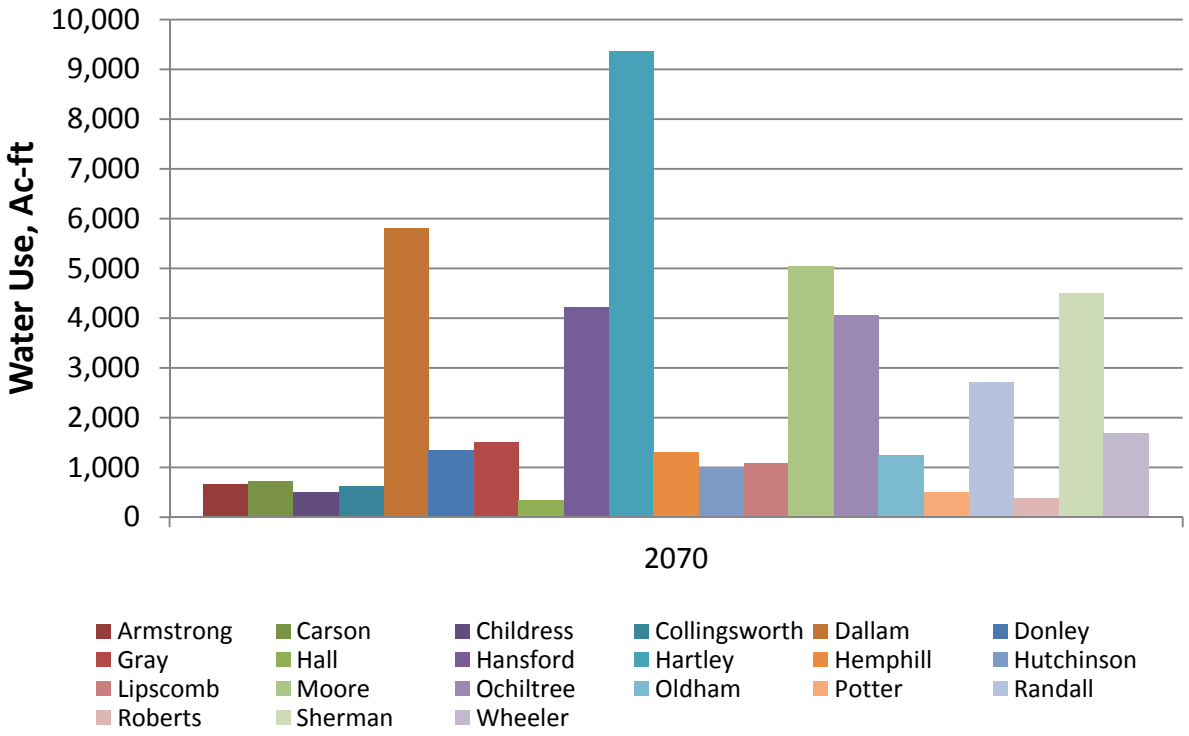

Figure 6. Region A 2016 RWP estimated livestock water use by county, 2070.

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.

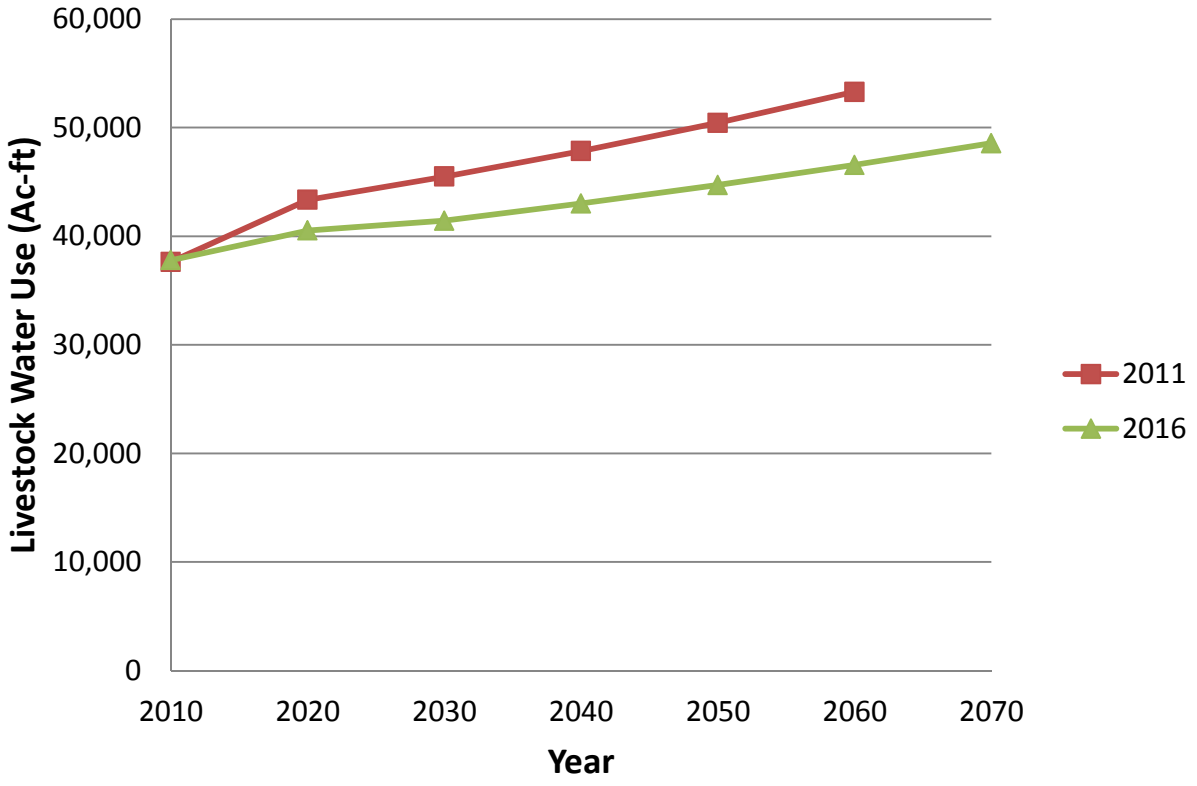

Figure 7. Region A comparison of estimated livestock water use between 2011 RWP and 2016 RWP for selected years.

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.