4B.2 Water Conservation

4B.2.1 Municipal Water Conservation

4B.2.1.1 Description of Option

Water conservation is defined as those methods and practices that either reduce the demand for water supply or increase the efficiency of the supply, or use facilities so that available supply is conserved and made available for future use. Water conservation is typically a non-capital intensive alternative that any water supply entity can and should pursue. All water supply entities and some major water right holders are required by Senate Bill 1 regulations to submit a Drought Contingency and Water Conservation Plan to the TCEQ for approval. These plans must detail the water supply entities' plans to reduce water demand at times when the demand threatens the total capacity of the water supply delivery system or overall supplies are low.

In 2001, the Texas Legislature amended the Texas Water Code, Texas Administrative Code 357.7(a)7(A), to require Regional Water Planning Groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). The Water Conservation Implementation Task Force was created by Senate Bill 1094 to identify and describe Water Conservation Best Management Practices (BMPs) and provide a BMP Guide for use by Regional Water Planning groups in the development of the 2006 Regional Water Plans. Two documents, GDS Associates Report[1] and Water Conservation Implementation Task Force Report,[2] provide guidance for municipal water conservation.

For regional water planning purposes, municipal water use is defined as residential and commercial water use. Municipal water is primarily for drinking, sanitation, cleaning, cooling, fire protection, and landscape watering for residential, commercial, and institutional establishments. A key parameter for assessing municipal water use within a typical city or water service area is the number of gallons used per person per day (per capita water use). The objective of water conservation is to decrease the amount of water – measured in gallons per person per day (gpcd) – that a typical person uses.

[1] "Quantifying the Effectiveness of Various Water Conservation Techniques in Texas," Texas Water Development Board, prepared by GDS Associates, Austin, Texas, July 2003.
[2] Water Conservation Implementation Task Force, Report to the 79th Legislature, Texas Water Development Board, Special Report, Austin, Texas, November 2004.

The Water Conservation Implementation Task Force recommends that a standardized methodology be used for determining per capita per day (gpcd) municipal water use so as to allow consistent evaluations of effectiveness of water conservation measures among Texas cities that are located in the different climates and parts of Texas. The Task force further recommends gpcd targets and goals that should be considered by retail public water suppliers when developing water conservation plans required by the state, as follows:

- All public water suppliers that are required to prepare and submit water conservation plans should establish targets for water conservation, including specific goals for per capita water use and for water loss programs using appropriate water conservation BMPs.
- Municipal Water Conservation Plans required by the state shall include per capita water-use goals, with targets and goals established by an entity giving consideration to a minimum annual reduction of 1 percent in total gpcd, based upon a 5-year moving average, until such time as the entity achieves a total gpcd of 140 gpcd or less, or
- Municipal water use (gpcd) goals approved by regional water planning groups.

The current Texas Water Development Board (TWDB) municipal water demand projections account for expected water savings due to implementation of the 1991 State Water-Efficient Plumbing Act. However, any projected water savings due to conservation programs over and above the savings associated with the 1991 Plumbing Act must be listed as a separate water management strategy. The savings projected by the TWDB include a 100 percent replacement of existing plumbing fixtures to water efficient fixtures by Year 2045 (assumed 2 percent per year replacement). The projections also assume that 100 percent of new construction includes water-efficient plumbing fixtures. Consequently, any water management strategy intended to replace inefficient plumbing fixtures installed prior to 1995 would constitute an acceleration of the effects of the 1991 Plumbing Act, but provide no additional long-term savings. Including a retrofit program as a water management strategy without first discounting the TWDB per capita water use reductions would double-count water savings, since those savings due to retrofits are already included in the base water demand projections.

Conservation is recommended for every municipal WUG with a projected need (shortage) and a per capita water use rate greater than 140 gallons per capita per day (gpcd) in 2060. The Brazos G Regional Water Planning Group (BGRWPG) recommends conservation for municipal WUGs with per capita rates greater than 140 gpcd based on the Water Conservation

Task Force's statewide gpcd target. This conservation can be achieved in a variety of ways, including using these BMPs identified by the Water Conservation Implementation Task Force:

1. System Water Audit and Water Loss,
2. Water Conservation Pricing,
3. Prohibition on Wasting Water,
4. Showerhead, Aerator, and Toilet Flapper Retrofit,
5. Residential Toilet Replacement Programs with Ultra-Low-Flow toilets,
6. Residential Clothes Washer Incentive Program,
7. School Education,
8. Water Survey for Single-Family and Multi-Family Customers,
9. Landscape Irrigation Conservation and Incentives,
10. Water-Wise Landscape Design and Conversion Programs,
11. Athletic Field Conservation,
12. Golf Course Conservation,
13. Metering of all New Connections and Retrofitting of Existing Connections,
14. Wholesale Agency Assistance Programs,
15. Conservation Coordinator,
16. Reuse of Reclaimed Water,
17. Public Information,
18. Rainwater Harvesting and Condensate Reuse,
19. New Construction Graywater,
20. Park Conservation, and
21. Conservation Programs for Industrial, Commercial, and Institutional Accounts.

The BGRWPG does not recommend specific conservation BMPs for each municipal entity, as each entity should choose those conservation strategies that best fit their individual situation. The TWDB requires that costs and water supply estimates be developed for each recommended water management strategy. However, the Task Force Report does not present methods for computing water savings and costs for each of the above BMPs, reducing the list of specific BMPs that can be used to compute costs and savings. Estimated water savings for municipal water conservation are presented in Table 4B.2-1 for specific BMPs. The BMPs presented in Table 4B.2-1 were used to provide a basis for estimating costs and expected water savings. A city may choose other BMPs not included in Table 4B.2-1 to reduce their per capita water use.

Table 4B.2-1.
Selected Municipal Water Conservation BMPs

Conservation BMP	Savings	Source
Advanced Conservation • Toilet retrofit • Showerheads and Aerators • Irrigation Audit – High User	7 gpcd*	GDS Associates, savings are for existing connections only
Landscape Irrigation	11 gpcd	Based upon 15% reduction referenced in Task Force report
Public Education Programs	3 gpcd	TCEQ
Total	**21 gpcd**	

* Note: This is an average for the WUGs analyzed, and represents 50 percent replacement of existing fixtures. In contrast, the TWDB maximum savings for a specific WUG in Region G (Brazos County-other) is about 13 gpcd, representing 100 percent replacement of existing fixtures for a WUG projected to have declining population and, consequently, minimal new construction.

If all of the programs listed in Table 4B.2-1 were implemented by a utility, an estimated total per capita water use reduction of 21 gpcd can be expected. This total reduction of 21 gpcd includes those reductions already incorporated into the TWDB demand projections. In order to meet both short and long-term needs, it is assumed that the 21 gpcd reductions will occur by Year 2020 for all municipal WUGs with needs, regardless of the timing of the needs. A portion of the 21 gpcd reduction is therefore an acceleration of the savings expected due to full implementation of the 1991 Plumbing Act. The savings shown in Table 4B.2-1 are average expected savings across the Brazos G Area. Actual expected savings are computed separately for each WUG.

4B.2.1.2 Available Supply

The available supply to any entity from this strategy would be the reduction in demand over and above that assumed in the TWDB water demand projections. All entities, in order to be in line with projections, will need to verify that their conservation planning measures are consistent with TCEQ standards and the TWDB projections. Beyond that, some communities with projected needs may be able to reduce or eliminate those needs with stronger conservation planning.

Table 4B.2-2 lists 39 municipal WUGs with per capita use rates greater than 140 gpcd, and projected shortages. The table also lists the potential additional water savings attributable to the BGRWPG conservation recommendations[3]. Please see the individual water supply plans presented in Section 4C to identify those WUGs for which conservation is a recommended water management strategy to meet needs.

Table 4B.2-2.
Municipal Water User Groups for which Conservation is a Recommended WMS

ID	County Name	Water User Group	Water Savings-with Conservation (acft)*					
			2010	2020	2030	2040	2050	2060
1	TAYLOR	ABILENE	977	2,189	1,785	1,346	1,173	1,136
2	SHACKELFORD	ALBANY	16	34	26	20	14	12
3	CALLAHAN	BAIRD	11	26	20	15	11	11
4	WILLIAMSON	BARTLETT	12	30	25	19	18	18
5	LIMESTONE	BISTONE MWSD	4	9	7	5	4	4
6	WILLIAMSON	BRUSHY CREEK MUD	92	124	133	133	133	133
7	WILLIAMSON	CEDAR PARK	461	1,557	1,593	1,935	1,935	1,936
8	WILLIAMSON	CHISHOLM TRAIL SUD	213	665	925	1,207	1,513	1,842
9	JOHNSON	CLEBURNE	240	580	519	482	488	532
10	BRAZOS	COLLEGE STATION	545	1,378	1,320	1,177	1,149	1,184
11	HILL	FILES VALLEY WSC	15	35	29	21	20	21
12	WILLIAMSON	FLORENCE	9	24	22	21	23	27
13	CORYELL	GATESVILLE	131	326	323	324	313	333
14	WILLIAMSON	GEORGETOWN	274	1,049	1,185	1,371	1,680	2,012
15	SOMERVELL	GLEN ROSE	22	47	41	32	28	29
16	HOOD	GRANBURY	55	158	148	156	165	193
17	MCLENNAN	HALLSBURG	4	10	8	6	6	6
18	HASKELL	HASKELL	23	47	36	26	19	18
19	WILLIAMSON	JARRELL-SCHWERTNER WSC	22	83	94	97	117	139
20	Kent	CITY OF JAYTON	3	8	6	3	3	2
21	JOHNSON	JOHNSON COUNTY SUD	491	1,485	2,085	3,008	4,241	5,171
22	CORYELL	KEMPNER WSC	81	241	265	272	268	283
23	KNOX	KNOX CITY	9	21	17	13	11	11
24	WILLIAMSON	LEANDER	129	393	430	489	603	727
25	WILLIAMSON	LIBERTY HILL	17	62	87	107	134	163
26	HOOD	LIPAN	5	16	19	23	31	44
27	FALLS	MARLIN	46	112	141	169	242	340
28	PALO PINTO	MINERAL WELLS	101	255	231	181	170	178
29	KNOX	MUNDAY	10	24	19	14	10	10
30	MCLENNAN	NORTH BOSQUE WSC	10	33	36	38	37	42
31	WILLIAMSON	ROUND ROCK	704	2,248	2,546	2,949	3,620	4,338
32	PALO PINTO	STRAWN	7	14	11	9	9	9
33	NOLAN	SWEETWATER	94	195	156	113	95	91
34	THROCKMORTON	THROCKMORTON	6	14	10	7	5	5
35	HOOD	TOLAR	6	15	16	14	13	15
36	BOSQUE	VALLEY MILLS	10	24	20	14	14	14
37	WILLIAMSON	WEIR	7	12	14	16	20	24
38	HILL	WHITE BLUFF COMMUNITY WSC	11	29	31	33	40	45
39	BRAZOS	BRYAN	--	--	--	--	122	248

* Note: This conservation is in addition to savings attributed to the 1991 Water Efficient Plumbing Fixtures Act. Conservation beyond Year 2020 is based on Year 2020 gpcd being held constant through Year 2060, except for cases where TWDB gpcd increases over time, in which case projected gpcd is reduced by 21 gpcd in each decade after 2020.

[3] Additional savings represents savings beyond the 1991 Plumbing Act savings.

4B.2.1.3 Environmental Issues

No substantial environmental impacts are anticipated, as water conservation is typically a non-capital intensive alternative that is not associated with direct physical impacts to the natural environment. A summary of the few environmental issues that might arise for this alternative are presented in Table 4B.2-3.

Table 4B.2-3.
Environmental Issues: Municipal Water Conservation

Water Management Option	*Municipal Water Conservation*
Implementation Measures	Voluntary reduction, reduced diversions, water pricing, mandatory restrictions (landscaping ordinances, watering days), reducing unaccounted for water
Environmental Water Needs / Instream Flows	No substantial impact identified, assuming relatively low reduction in diversions and return flows; substantial reductions in municipal and industrial diversions from water conservation would result in possibly low to moderate positive impacts as more stream flow would be available for environmental water needs and instream flows
Bays and Estuaries	No substantial impact identified, assuming relatively low reduction in diversions and return flows
Fish and Wildlife Habitat	No substantial impact identified, assuming relatively low reductions in diversions and return flows; possible low to moderate positive impact to aquatic and riparian habitats with substantial reductions as more stream flow would be available to these habitats; possible moderate positive benefits from implementation of site-specific xeriscape landscaping
Cultural Resources	No substantial impact anticipated
Threatened and Endangered Species	No substantial impact identified, assuming relatively low reduction in diversions and return flows; possible low to moderate positive impact to aquatic and riparian threatened and endangered species (where they occur) with substantial diversion reductions
Comments	Assumes no substantial change in infrastructure with attendant landscape impacts; further assumes that infrastructure improvements which do occur will largely be in urbanized settings

4B.2.1.4 Engineering and Costing

Since water conservation plans are required for each community by Senate Bill 1, regular costs for implementing and enforcing a general conservation program were not estimated. Only the efforts needed to enforce a more stringent conservation plan over and above that assumed in the projections were studied. These might include those BMPs included in Table 4B.2-1 or other conservation measures as deemed appropriate by each individual entity. Based upon the costs obtained for the selected BMPs from the GDS Associates report updated to September 2008 dollars (Table 4B.2-4), the average cost per acft of water saved would be between $425 and $525. An average cost of $475 per acre-foot is assumed for purposes of assigning a cost to the water conservation strategy. This is the cost associated with water savings above those already included in the TWDB water demand projections.

Table 4B.2-4.
Savings and Costs Associated with Municipal Water Conservation

Conservation BMP	***Savings***	***Estimated Cost ($/acft of water saved)***
Advanced Conservation		
• Toilet retrofit	7 gpcd*	$425 to $504
• Showerheads and Aerators		
• Irrigation Audit – High User		
Landscape Irrigation	11 gpcd	$525
Public Education Programs	3 gpcd	N/A
Total	**21 gpcd**	**$425 to $525**

* Note: This is an average for the WUGs analyzed, and represents 50 percent replacement of existing fixtures. In contrast, the TWDB maximum savings for a specific WUG in Region G (Brazos County-other) is about 13 gpcd, representing 100 percent replacement of existing fixtures for a WUG projected to have declining population and, consequently, minimal new construction.

4B.2.1.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 4B.2-5, and the option meets each criterion.

4B.2.2 Irrigation Water Conservation

4B.2.2.1 Description of Strategy

Irrigation water use is the use of freshwater that is pumped from aquifers and/or diverted from streams and reservoirs of the planning area and applied directly to grow crops, orchards, and hay and pasture in the study area. Irrigation water is typically applied to land by: (1) flowing or flooding water down furrows; and (2) the use of sprinklers. When groundwater is used, irrigation wells are usually located within the fields to be irrigated. For surface water supplies, typically water is diverted from the source and conveyed by canals and pipelines to the fields. For both groundwater and surface water, the conservation objective is to reduce the quantity of water that is lost to deep percolation and evaporation between the originating points (wells in the case of groundwater, and stream diversion points in the case of surface water), and the irrigated crops in the fields. Thus, the focus is upon investments in irrigation application equipment, instruments, and conveyance facility improvements (canal lining and pipelines) to reduce seepage losses, deep percolation, and evaporation of water, and management of the irrigation processes to improve efficiencies of irrigation water use and reduce the quantities of water needed to accomplish irrigation.

Table 4B.2-5.
Comparison of Municipal Water Conservation Option to Plan Development Criteria

Impact Category	***Comment(s)***
A. Water Supply 1. Quantity 2. Reliability 3. Cost	 1. Variable, dependent on current per capita rate 2. Variable, dependent on public acceptance 3. Reasonable
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries 5. Threatened and Endangered Species 6. Wetlands	 1. None or low impact 2. No apparent negative impact 3. None 4. None or low impact 5. None or low impact 6. None or low impact
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• None
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal shortages
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• Not applicable

In the 37 counties of the Brazos G Area, irrigation varies from county to county along with the crops irrigated. In 2000, crops grown on irrigated acres in the Brazos G Area included alfalfa, corn, cotton, sorghum, hay-pasture, forage crops, peanuts, pecans, wheat and other grains, and vegetables. According to TWDB estimates, the entire Brazos G Area had 217,916 irrigated acres in 2000 with approximately 75 percent of the acreage planted to cotton, hay-pasture, peanuts, and wheat and other grains. Table 4B.2-6 summarizes the variety of crops grown in the Brazos G Area and number of irrigated acres for each crop in each county in 2000.

In 1994, irrigators in the Brazos G Area used 202,460 acft of water, of which nearly 80 percent was from groundwater sources. In 2000, the TWDB estimated that the irrigators used 233,686 acft (an increase of 15 percent over 1994). This increase is due to an increase in irrigated acreage of 1.8 percent and increased application rates, which changed from 0.95 acft/acre in 1994 to 1.07 acft/acre in 2000.

The TWDB irrigation water demand projections for the Brazos G Area predict significant decreases in irrigation usage in the future, declining to 222,691 acft/yr by 2030 and 208,386 acft/yr by 2060 (Volume I, Table 2-7). This decline in water use is attributable to expected reductions in irrigated land and partly to increased efficiencies.

In the Brazos G Area, six counties are projected to have irrigation needs (shortages) during the 2000 to 2060 planning period, as shown in Table 4B.2-7: Eastland, Haskell, Knox, Nolan, Shackelford, and Throckmorton. The predominant crops in these counties are cotton and wheat/other grains, constituting 45 percent and 25 percent of the irrigated acres, respectively (Table 4B.2-6).

Irrigation shortages range from less than 100 acft/yr in Shackelford County to greater than 28,000 acft in Haskell County (2010). Generally, the shortages decrease over time except for Eastland County, where minimal increases in shortages (less than 100 acft/yr) are anticipated from 2010 to 2060. Four of the six counties (Eastland, Haskell, Knox, and Nolan) use both surface water and groundwater supplies to meet irrigation water demands. Shackelford County and Throckmorton County irrigators receive surface water supplies.

TWDB rules for regional water planning require regional water planning groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). In addition, the rules direct water conservation "Best Management Practices," as identified by the Water Conservation Implementation Task Force (Task Force), be considered in the development of the water conservation water management strategy. The irrigation demand in Throckmorton County is new, and no conservation savings are expected because it is anticipated that modern, efficient methods of water application will be employed.

Table 4B.2-6. Irrigated Acres by Crop (2000) in the Brazos G Area

County	alfalfa	corn	cotton	forage crops	grain sorghum	hay-pasture	other orchard	peanuts and other oil crops	pecans	soybeans	vegetables	wheat and other grains	all other crops	Total
Bell	0	520	80	0	0	1,141	61	0	0	0	35	110	0	1,947
Bosque	0	220	0	241	0	657	0	754	50	0	0	175	60	2,157
Brazos	0	2,147	5,437	0	381	0	25	0	0	263	0	0	0	8,253
Burleson	0	2,743	11,348	0	686	0	0	0	0	3,137	0	0	1,000	18,914
Callahan	0	0	0	0	0	1,135	0	125	0	0	0	0	0	1,260
Comanche	125	0	0	4,050	0	5,078	0	6,097	9,482	0	1,450	1,772	0	28,054
Coryell	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastland	166	0	0	1,860	538	6,424	0	3,655	53	0	293	1,232	0	14,221
Erath	0	0	0	3,646	0	3,002	0	1,829	0	0	32	0	56	8,565
Falls	0	2,229	0	0	0	15	0	0	27	0	60	0	0	2,331
Fisher	136	0	2,081	125	0	575	0	0	0	0	0	160	0	3,077
Grimes	0	0	504	0	0	60	10	0	40	0	102	0	0	716
Hamilton	0	100	0	0	0	358	0	0	0	0	0	40	22	520
Haskell	146	4	18,699	560	291	1,909	0	7,599	11	0	367	10,117	0	39,703
Hill	0	0	0	0	0	0	0	0	0	0	0	0	26	26
Hood	0	0	0	0	0	190	0	0	1,560	0	0	0	840	2,590
Johnson	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jones	100	0	3,085	0	1,500	2,200	0	1,200	0	0	0	1,500	0	9,585
Kent	19	0	0	0	92	195	0	0	45	0	0	304	21	676
Knox	0	0	17,704	144	680	683	0	1,295	67	0	722	17,156	34	38,485
Lampasas	0	58	0	0	0	60	0	40	1	0	0	0	2	161
Lee	0	46	0	0	0	1,252	20	121	141	31	0	0	0	1,611
Limestone	0	0	0	0	0	0	0	0	0	0	0	0	0	0
McLennan	0	915	1,850	0	0	130	0	180	212	0	50	0	635	3,972
Milam	0	1,074	136	3,868	0	748	0	0	5	60	0	0	40	5,931
Nolan	0	0	2,345	0	0	250	0	0	38	0	20	203	35	2,891
Palo Pinto	0	0	0	0	0	735	0	0	0	0	0	0	252	987
Robertson	0	4,879	11,994	0	0	749	0	0	254	0	0	0	12	17,888
Shackelford	17	0	0	110	15	17	0	0	0	0	0	158	0	317
Somervell	0	0	0	0	0	160	0	0	0	0	0	0	210	370
Stephens	0	0	0	0	0	260	0	0	0	0	0	463	0	723
Stonewall	40	0	77	0	0	73	0	94	0	62	0	64	0	410
Taylor	0	0	150	0	200	330	0	0	0	0	0	190	0	870
Throckmorton	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	85	40	0	265	0	0	0	173	563
Williamson	0	0	0	0	0	10	0	0	20	0	0	0	50	80
Young	0	0	0	0	0	60	0	0	2	0	0	0	0	62
Total	**749**	**14,935**	**75,490**	**14,604**	**4,383**	**28,541**	**156**	**22,989**	**12,273**	**3,553**	**3,131**	**33,644**	**3,468**	**217,916**
Percent	**0.3**	**6.9**	**34.6**	**6.7**	**2.0**	**13.1**	**0.1**	**10.5**	**5.6**	**1.6**	**1.4**	**15.4**	**1.6**	**100**

Table 4B.2-7. Projected Irrigation Water Demands, Supplies, and Needs (Shortages) in Counties Having Projected Irrigation Shortages

	Projections (acft/yr)						
County	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Eastland							
Irrigation Demand	16,274	16,302	16,327	16,352	16,370	16,377	16,385
Irrigation Existing Supply							
Groundwater	4,563	4,563	4,563	4,563	4,563	4,563	4,563
Surface water	2,404	2,404	2,404	2,404	2,404	2,404	2,404
Total Irrigation Supply	6,967	6,967	6,967	6,967	6,967	6,967	6,967
Shortage	(9,307)	(9,335)	(9,360)	(9,385)	(9,403)	(9,410)	(9,418)
Haskell							
Irrigation Demand	50,820	49,309	47,844	46,422	45,040	43,702	42,405
Irrigation Existing Supply							
Groundwater	19,360	19,360	19,360	19,360	19,360	19,360	19,360
Surface water	847	844	841	839	836	833	830
Total Irrigation Supply	20,207	20,204	20,201	20,199	20,196	20,193	20,190
Shortage	(30,613)	(29,105)	(27,643)	(26,223)	(24,844)	(23,509)	(22,215)
Knox							
Irrigation Demand	43,124	42,065	41,033	40,025	39,041	38,082	37,147
Irrigation Existing Supply							
Groundwater	23,807	23,807	23,807	23,807	23,807	23,807	23,807
Surface water	2,951	2,951	2,951	2,951	2,951	2,951	2,951
Total Irrigation Supply	26,758	26,758	26,758	26,758	26,758	26,758	26,758
Shortage	(16,366)	(15,307)	(14,275)	(13,267)	(12,283)	(11,324)	(10,389)
Nolan							
Irrigation Demand	5,276	5,138	5,003	4,871	4,741	4,618	4,497
Irrigation Existing Supply							
Groundwater	3,286	3,286	3,286	3,286	3,286	3,286	3,286
Surface water	120	120	120	120	120	120	120
Total Irrigation Supply	3,406	3,406	3,406	3,406	3,406	3,406	3,406
Shortage	(1,870)	(1,732)	(1,597)	(1,465)	(1,335)	(1,212)	(1,091)
Shackelford							
Irrigation Demand	195	189	183	178	173	168	163
Irrigation Existing Supply							
Groundwater	0	0	0	0	0	0	0
Surface water	85	85	85	85	85	85	85
Total Irrigation Supply	85	85	85	85	85	85	85
Shortage	(110)	(104)	(98)	(93)	(88)	(83)	(78)
Throckmorton							
Irrigation Demand	0	4,000	4,000	4,000	4,000	4,000	4,000
Irrigation Existing Supply							
Groundwater	0	0	0	0	0	0	0
Surface water	12	12	12	12	12	12	12
Total Irrigation Supply	12	12	12	12	12	12	12
Shortage	12	(3,988)	(3,988)	(3,988)	(3,988)	(3,988)	(3,988)

4B.2.2.2 Available Yield

In February 2005, the Brazos G RWPG recommended that counties with projected irrigation needs (shortages) reduce their irrigation water demands by 3 percent by 2010, 5 percent by 2020, and 7 percent from 2030 to 2060 by using Best Management Practices (BMPs) identified by the Task Force. A reduction in irrigation water demand subsequently reduces shortages for each decade, if water supplies remain constant. In 2060, with conservation reductions, the shortage reductions would range between 12 percent for Eastland County to 25 percent for Knox County (Table 4B.2-8). The maximum water savings expected amongst the six counties is for Haskell County, with a recommended savings of 3,250 acft/yr in 2030.

Table 4B.2-8.
Projected Water Demands and Needs (Shortages) for
Irrigation Users after Recommended Irrigation Water Conservation

Counties	2010	2020	2030	2040	2050	2060
Eastland						
New Demand (acft/yr)	15,813	15,511	15,207	15,224	15,231	15,238
Expected Savings (acft/yr)	*489*	*816*	*1,145*	*1,146*	*1,146*	*1,147*
New shortage (acft/yr)	(8,846)	(8,544)	(8,240)	(8,257)	(8,264)	(8,271)
Shortage Reduction (acft/yr)	5%	9%	12%	12%	12%	12%
Haskell						
New Demand (acft/yr)	47,830	45,452	43,172	41,887	40,643	39,437
Expected Savings (acft/yr)	*1,479*	*2,392*	*3,250*	*3,153*	*3,059*	*2,968*
New shortage (acft/yr)	(27,626)	(25,251)	(22,973)	(21,691)	(20,450)	(19,247)
Shortage Reduction (acft/yr)	5%	9%	12%	13%	13%	13%
Knox						
New Demand (acft/yr)	40,803	38,981	37,223	36,308	35,416	34,547
Expected Savings (acft/yr)	*1,262*	*2,052*	*2,802*	*2,733*	*2,666*	*2,600*
New shortage (acft/yr)	(14,045)	(12,223)	10,465)	(9,550)	(8,658)	(7,789)
Shortage Reduction (acft/yr)	8%	14%	21%	22%	24%	25%
Nolan						
New Demand (acft/yr)	4,984	4,753	4,530	4,409	4,295	4,182
Expected Savings (acft/yr)	*154*	*250*	*341*	*332*	*323*	*315*
New shortage (acft/yr)	(1,578)	(1,347)	(1,124)	(1,003)	(889)	(776)
Shortage Reduction (acft/yr)	9%	16%	23%	25%	27%	29%
Shackelford						
New Demand (acft/yr)	183	174	166	161	156	152
Expected Savings (acft/yr)	*6*	*9*	*12*	*12*	*12*	*11*
New shortage (acft/yr)	(98)	(89)	(82)	(77)	(72)	(69)
Shortage Reduction (acft/yr)	6%	9%	13%	13%	14%	14%

Thockmorton County had no irrigation water use in 2000 according to the TWDB. The irrigation demand projections for Throckmorton County are reflective of this with a demand of 0 acft/yr in 2000 and 4,000 acft/yr from 2010 through 2060. It is assumed that since this appears to be new irrigation in the county, the irrigators will utilize the most efficient means to irrigate their crops; therefore, no additional irrigation conservation is recommended for Throckmorton County.

The Task Force report[4] lists the following irrigation BMPs that may be used to achieve the recommended water savings:

1. Irrigation Scheduling;
2. Volumetric Measurement of Irrigation Water Use;
3. Crop Residue Management and Conservation Tillage;
4. On-Farm Irrigation Audit;
5. Furrow Dikes;
6. Land Leveling;
7. Contour Farming;
8. Conservation of Supplemental Irrigated Farmland to Dry-Land Farmland;
9. Brush Control/Management;
10. Lining of On-Farm Irrigation Ditches;
11. Replacement of On-Farm Irrigation Ditches with Pipelines;
12. Low-Pressure Center Pivot Sprinkler Irrigation Systems;
13. Drip/Micro-Irrigation Systems;
14. Gated and Flexible Pipe for Field Water Distribution Systems;
15. Surge Flow Irrigation for Field Water Distribution Systems;
16. Linear Move Sprinkler Irrigation Systems;
17. Lining of District Irrigation Canals;
18. Replacement of District Irrigation Canals and Lateral Canals with Pipelines;
19. Tailwater Recovery and Use Systems; and
20. Nursery Production Systems.

The Task Force report describes the above BMP methods and how they reduce irrigation water use; however, information regarding specific water savings and costs to install irrigation water saving systems is generally unavailable. The Task Force report does include water savings and costs for three irrigation water conservation BMPs: (1) furrow dikes; (2) low-pressure

[4] Water Conservation Implementation Task Force, Report to the 79th Legislature, Texas Water Development Board, Special Report, Austin, Texas, November 2004.

sprinklers (LESA); and (3) low-energy precision application systems (LEPA). These major irrigation water conservation techniques applicable in the Brazos G Area are described briefly below.

Furrow dikes are small mounds of soil mechanically installed a few feet apart in the furrow. These mounds of soil create small reservoirs that capture precipitation and hold it until it soaks into the soil instead of running down the furrow and out the end of the field. This practice can conserve (capture) as much as 100 percent of rainfall runoff, and furrow dikes are used to prevent irrigation runoff under sprinkler systems. This maintains high irrigation uniformity and increases irrigation application efficiencies. Capturing and holding precipitation that would have drained from the fields replaces required irrigation water. Furrow dikes have been demonstrated to be useful management tools on both irrigated and non-irrigated cropland. Use of furrow dikes can have water savings up to 12 percent of the gross quantity of water applied using sprinkler irrigation. If all six counties with projected irrigation shortages (excluding Throckmorton County) in the Brazos G Area install furrow dikes, the expected water savings could be up to 11,462 acft/yr, assuming 100 percent participation of irrigated lands with sprinkler systems. Furrow dikes require special tillage equipment and cost $7 to $39 per acre to install.

Low-pressure sprinklers (LESA), with 90 percent application efficiency, improve irrigation application efficiency in comparison to conventional furrow irrigation by reducing water requirements per acre by between 10 and 25 percent. Low-pressure sprinklers spray water into the atmosphere above the crops as the sprinkler systems are moved across the fields. In the six Brazos G counties with projected water needs (excluding Throckmorton County), conversion to LESA systems would save about 0.14 to 0.25 acft/acre converted and result in a total savings of 16,567 acft/yr.

LEPA systems involve a sprinkler system that has been modified to discharge water directly into furrows at low pressure, thus reducing evaporation losses. When used in conjunction with furrow dikes, LEPA systems can accomplish the irrigation objective with less water than is required for the furrow irrigation and pressurized sprinkler methods. When used with furrow dike systems, the expected water savings from LEPA would range from 0.17 acft/acre to 0.30 acft/acre (a total reduction in water use of 16 to 37 percent). Use of LEPA and furrow dikes allows irrigation farmers to produce equivalent yields per acre at lower energy and labor costs. It has been demonstrated that LEPA systems improve production and profitability of irrigation farming. The barriers to installation are high capital costs; with no assurance (at the present time) that the water saved would be available to the irrigator who incurred the costs.

A comparison of irrigation rates for furrow dikes, LESA, and LEPA systems to irrigation rates before irrigation water conservation are shown in Table 4B.2-9.

4B.2.2.3 Environmental Issues

The irrigation water conservation methods described above have been developed and tested through public and private sector research, and have been adopted and applied within the region. Hundreds of LEPA systems have been installed and are in operation today, and experience has shown that there are no significant environmental issues associated with this water management strategy. This method improves water use efficiency without making changes to wildlife habitat. This method of application, when coupled with furrow dikes, reduces runoff of both applied irrigation water and rainfall. The results are reduced transport of sediment and any fertilizers or other chemicals that have been applied to the crops. Thus, the proposed conservation practices do not have potential adverse effects, and may have potentially beneficial environmental effects.

4B.2.2.4 Engineering and Costing

The Brazos G RWPG recommended irrigation water conservation (7 percent reduction in demands) as a water management strategy for irrigation needs, resulting in a maximum water savings of 7,552 acft/yr. Furrow dikes could save up to 11,461 acft/yr at an average unit cost of $308 per acft (Table 4B.2-10). Installing LESA or LEPA systems would incur a greater capital cost, and therefore higher annual costs, however both achieve a substantially higher water savings potential and therefore have more economical unit cost ($/acft) when compared to furrow dikes. The maximum water conservation potential can be realized by using the LEPA system, as shown in Table 4B.2-10. The capital cost to install LEPA irrigation is approximately $524 per acre.[5] It is estimated that it would take a total investment of $40.2 million to equip the estimated 76,707 irrigated acres currently served by sprinkler systems within five of the six counties (Throckmorton excluded) with projected irrigation shortages. This investment, at an annual cost of $3.5 million (20 years at 6 percent), would save an estimated 20,722 acft/yr at an average unit cost of $169 per acft of water saved.

[5] Ibid.

Table 4B.2-9.
Region G Irrigated Acreages and Effects of Water Conservation on Irrigation Water Use and Application Rates

County	Acreage Irrigated with Sprinklers (2000)	Without Conservation		With Conservation								
				Furrow Dikes[1]			LESA[2]			LEPA[3]		
		Irrigation Water Use (acft)	Irrigation Rate (acft per acre)	Irrigation Water Use (acft)	Irrigation Rate (acft per acre)	Estimated water savings (acft)	Irrigation Water Use (acft)	Irrigation Rate (acft per acre)	Estimated water savings (acft)	Irrigation Water Use (acft)	Irrigation Rate (acft per acre)	Estimated water savings (acft)
Eastland	14,221	16,274	1.14	14,321	1.01	1,953	12,658	0.89	3,616	11,991	0.84	4,283
Haskell	31,107	44,584	1.43	39,234	1.26	5,350	37,153	1.19	7,431	35,198	1.13	9,386
Knox	28,647	29,846	1.04	26,264	0.92	3,581	24,871	0.87	4,974	23,562	0.82	6,283
Nolan	2,575	4,709	1.83	4,144	1.61	565	4,185	1.63	523	3,965	1.54	743
Shackelford	157	102	0.65	90	0.57	12	79	0.50	23	75	0.48	27

[1] 12 percent savings of water applied using sprinkler irrigation.
[2] Assumes application efficiency of 90 percent.
[3] Assumes application efficiency of 95 percent.

**Table 4B.2-10.
Potential Water Savings and Costs (Total Project, Annual Average, and Unit Costs)
to Implement Irrigation Water Conservation Best Management Practices**

County	Maximum Desired Water Savings (acft)	Furrow Dikes			LESA (90% efficiency)				LEPA (95% efficiency)			
		Max. Amt. Saved (acft)	Annual Cost[1] (average)	Avg. Cost per acft	Max. Amt. Saved (acft)	Total Project Cost (average)	Annual Cost[1] (average)	Avg. Cost per acft	Max. Amt. Saved (acft)	Total Project Cost (average)	Annual Cost[1] (average)	Avg. Cost per acft
Eastland	1,147	**1,953**	$327,083	$335	**3,616**	$7,451,804	$649,682	$180	**4,283**	$7,451,804	$649,682	$152
Haskell	3,250	**5,350**	$715,461	$267	**7,431**	$16,300,068	$1,421,114	$191	**9,386**	$16,300,068	$1,421,114	$151
Knox	2,802	**3,581**	$658,881	$368	**4,974**	$15,011,028	$1,308,730	$263	**6,283**	$15,011,028	$1,308,730	$208
Nolan	341	**565**	$59,225	$210	**523**	$1,349,300	$117,638	$225	**743**	$1,349,300	$117,638	$0
Shackelford	12	**12**	$3,611	$591	**23**	$82,268	$7,172	$317	**27**	$82,268	$7,172	$268
Total	**7,552**	**11,461**	**$1,764,261**	**$308**	**16,567**	**$40,194,468**	**$3,504,336**	**$212**	**20,722**	**$40,194,468**	**$3,504,336**	**$169**

[1] Annual costs calculated assuming debt service for 20 years at 6 percent interest.

Each of the three irrigation water conservation strategies described (furrow dikes, LESA, and LEPA) have the potential to increase water savings beyond the minimum recommended by the Brazos G RWPG; however, none of the strategies can accomplish water savings sufficient to meet all of the projected needs. Further studies are needed to consider other irrigation water conservation BMPs that can be applied to surface applications to increase their application efficiencies.

It may not be economically feasible for agricultural producers to pay for additional water supplies to meet projected irrigation water needs (shortages), even if such supplies were available. For example, in 2004, the estimated income for irrigated cotton remaining after other production expenses had been paid was about $68 per acre, and the income for wheat with high input management was about $65 per acre. At an application rate of about 1 acft/acre, the cost of water from other sources far exceeds these values. For example, costs for water management strategies (new reservoirs) considered to meet projected municipal needs ranged between $210 per acft and $1,176 per acft for raw water supply at the reservoirs. The costs greatly exceed the income that would be realized from land irrigated with these water supplies.

4B.2.2.5 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Brazos G Area and the State of Texas. The rate of adoption of efficient water-use practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is widespread public support for irrigation water conservation and it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach its maximum potential. A major barrier to implementation of water conservation is financing. The TWDB has irrigation conservation programs that may provide funding to irrigators to implement irrigation BMPs that increase water use efficiency. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of additional irrigation conservation.

This option is compared to the plan development criteria in Table 4B.2-11 and the options meets most criteria.

Table 4B.2-11.
Comparison of Irrigation Water Conservation Option to Plan Development Criteria

Impact Category	***Comment(s)***
A. Water Supply	
1. Quantity	1. Firm Yield: Variable according to BMP selected. Ranges from 11,461 acft/yr to 20,722 acft/yr
2. Reliability	2. High reliability
3. Cost	3. High for internal use: Ranges from $169 to $308 per acft water saved (based on BMP selected)
B. Environmental factors	
1. Environmental Water Needs	1. None or low impact
2. Habitat	2. None or low impact
3. Cultural Resources	3. No apparent negative impact
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. None
6. Wetlands	6. No cultural resources affected
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• None
E. Equitable Comparison of Strategies Deemed Feasible	• Standard analyses and methods used
F. Requirements for Interbasin Transfers	• None
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

4B.2.3 Water Conservation for Industrial Uses

4B.2.3.1 Description of Strategy

Water uses for industrial purposes (manufacturing, steam-electric power generation, and mining) are primarily associated with manufacturing products, cleaning and waste removal, waste heat removal, dust control, landscaping, and mine dewatering. In the Brazos G Area, industrial water demands amounted to 193,123 acft/yr in 2000 (24% total water demand) and are projected to increase to 373,069 acft/yr in 2060 (30% of total water demand) as shown in Table 4B.2-12.

Table 4B.2-12.
Projected Water Demands, Supplies, and Needs (Shortages) for Industrial Uses in the Brazos G Area

	Projections (acft/yr)						
	2000	***2010***	***2020***	***2030***	***2040***	***2050***	***2060***
Manufacturing							
Demand	16,939	19,787	23,201	25,077	26,962	30,191	31,942
Existing Supply							
Groundwater	13,843	16,710	16,710	16,710	16,710	16,710	16,710
Surface water	35,185	35,876	36,364	36,816	37,273	37,676	38,239
Total Supply	49,041	52,493	52,981	53,433	53,983	54,386	54,949
Manufacturing Balance	32,102	32,706	29,780	28,356	27,021	24,195	23,007
Steam-Electric							
Demand	103,330	168,193	221,696	254,803	271,271	300,859	319,884
Existing Supply							
Groundwater	9,585	9,119	9,119	9,119	9,119	9,119	9,119
Surface water	235,701	257,070	258,396	257,804	257,232	256,650	256,069
Total Supply	245,286	266,189	267,515	266,923	266,351	265,769	265,188
Steam-Electric Balance	141,956	97,996	45,819	12,120	(4,920)	(35,090)	(54,696)
Mining							
Demand	72,854	36,664	37,591	38,037	27,251	20,744	21,243
Existing Supply							
Groundwater	49,285	28,657	28,725	28,753	17,628	10,717	10,755
Surface water	4,269	4,272	4,275	4,278	4,282	4,285	4,288
Total Supply	53,554	32,929	33,000	33,031	21,910	15,002	15,043
Mining Balance	(19,300)	(3,735)	(4,591)	(5,006)	(5,341)	(5,742)	(6,200)
Total Industrial							
Demand	193,123	224,644	282,488	317,917	325,484	351,794	373,069
Existing Supply							
Groundwater	72,726	54,393	54,461	54,489	43,457	36,546	36,584
Surface water	275,154	297,218	299,035	298,898	298,786	298,611	298,596
Total Supply	347,880	351,611	353,496	353,387	342,243	335,157	335,180
Total Industrial Balance	154,757	126,967	71,008	35,470	16,759	(16,637)	(37,889)

Manufacturing is a significant part of the Brazos G Area's economy, and industries use water as a component of the final product, for cooling, and cleaning/wash-down of parts and/or products. Regional industries that are major water users include food and kindred products, apparel, fabricated metal, machinery, and stone and concrete production. Manufacturing water demand is projected at 19,787 acft/yr in 2010 and expected to increase to 31,942 acft/yr by 2060. There are five counties in the Brazos G Area with projected manufacturing needs: Johnson, Lampasas, Limestone, Nolan, and Williamson. In 2060, the estimated water needs are 10,924 acft/yr, which is 34% of the manufacturing water demand for the Brazos G Area.

In the Brazos G Area, the trends for steam-electric water demands are projected to increase each decade with a maximum demand of 319,884 acft/yr by 2060. Grimes, Limestone, McLennan, Nolan, Robertson, and Somervell Counties comprise over 80 percent of the projected regional steam-electric water use in 2060. The increase in water demand is due to projected increases in population and manufacturing growth and estimated increases in fresh water use based on projected power generation capacities. The Brazos G Area steam-electric users receive 96% of their water supplies from surface water sources. There are ten counties in the Brazos G Area with projected steam-electric needs: Bell, Bosque, Grimes, Johnson, Limestone, McLennan, Milam, Nolan, Robertson, and Somervell. In 2060, the estimated water needs are 132,871 acft/yr, which is 42% of the steam-electric water demand for the Brazos G Area.

Gross state product data released from the U.S. Department of Commerce shows mining economic outputs of $37.6 billion for 1999 and $29.9 billion for 2000.[6] The TWDB water demand projections for mining users is generally based on projected economic output, assuming that past and current water use trends remain constant over time. In the Brazos G Area, the trends for mining water demands are projected to decrease during the planning period from 36,664 acft/yr in 2010 to 21,243 acft/yr by 2060, largely due to projected closure of the Sandow Mine in Milam County. In 2000, the Brazos G Area mining users received 92% of their water supplies from groundwater sources. Groundwater use is expected to decline to 71% of the regional mining water supply by 2060. There are three counties in the Brazos G Area with projected mining needs: Nolan, Stephens, and Williamson. In 2060, the estimated water needs are 12,156 acft, which is 57% of the steam-electric water demand for the Brazos G Area.

[6] TWDB, "Water Demand Methodology and Projections for Mining and Manufacturing," March 2003.

TWDB Rules for regional water planning require Regional Water Planning Groups to consider water conservation and drought management measures for each water user group with a need (projected water shortage). In addition, the Rules direct that water conservation BMPs, as identified by the Water Conservation Implementation Task Force (Task Force), be considered in the development of the water conservation water management strategy.

4B.2.3.2 Available Yield

In February 2005, the Brazos G RWPG recommended that counties with projected needs (shortages) for industrial users (manufacturing, steam electric, or mining) reduce those water demands by 3 percent by 2010, 5 percent by 2020, and 7 percent from 2030 to 2060 by using Best Management Practices identified by the Water Conservation Implementation Task Force.

For the five manufacturing users with projected needs, the total water savings after 7 percent water demand reduction in 2060 is 594 acft/yr (a 10% reduction in total regional manufacturing shortages) as shown in Table 4B.2-13.

For the ten steam-electric users with projected needs, the total water savings after 7 percent water demand reduction in 2060 is 20,977 acft/yr (a 25% reduction in total regional steam-electric shortages) as shown in Table 4B.2-14. Bell, Nolan and Somervell Counties have significant increases in steam-electric demands during the planning period. It is assumed that with these new demands generating facilities will utilize the most water efficient means appropriate to produce power; therefore, no additional steam-electric conservation is recommended for Bell, Nolan and Somervell counties.

For the three mining users with projected needs, the total water savings after 7 percent water demand reduction in 2060 is 973 acft/yr (a 16% reduction in total regional mining shortages) as shown in Table 4B.2-15.

The Task Force report lists the following industrial BMPs that may be used to achieve the recommended water savings:[7]

1. Industrial Water Audit,
2. Industrial Water Waste Reduction,
3. Industrial Submetering,
4. Cooling Towers,
5. Cooling Systems (other than Cooling Towers),

[7] Water Conservation Implementation Task Force, Report to the 79th Legislature, Texas Water Development Board,

6. Industrial Alternative Sources and Reuse and Recirculation of Process Water,
7. Rinsing/Cleaning,
8. Water Treatment,
9. Boiler and Steam Systems,
10. Refrigeration (including Chilled Water),
11. Once-Through Cooling,
12. Management and Employee Programs,
13. Industrial Landscape, and
14. Industrial Site Specific Conservation.

Table 4B.2-13. Projected Water Demands and Needs (Shortages) for Manufacturing Users Considering up to a 7 Percent Demand Reduction by 2030

	Projections (acft/yr)					
	2010	*2020*	*2030*	*2040*	*2050*	*2060*
Johnson						
New Demand	2,057	2,391	2,700	3,064	3,391	3,714
Expected Savings	64	126	203	231	255	280
New Shortage	(1,295)	(1,629)	(1,938)	(2,322)	(2,629)	(2,952)
Shortage Reduction	5%	7%	9%	9%	9%	9%
Lampasas						
New Demand	125	135	142	153	162	174
Expected Savings	4	7	11	11	12	13
New Shortage	(107)	(117)	(124)	(135)	(144)	(156)
Shortage Reduction	4%	6%	8%	8%	8%	8%
Limestone						
New Demand	47	50	54	59	62	67
Expected Savings	1	3	4	4	5	5
New Shortage	(17)	(25)	(35)	(45)	(54)	(64)
Shortage Reduction	6%	11%	10%	8%	8%	7%
Nolan						
New Demand	756	869	965	1,078	1,177	1,276
Expected Savings	23	46	73	81	89	96
New Shortage	—	—	—	—	—	—
Shortage Reduction	—	—	—	—	—	100%
Williamson						
New Demand	1,539	1,761	1,971	2,221	2,446	2,656
Expected Savings	48	93	149	167	184	200
New Shortage	(1,203)	(1,425)	(1,635)	(1,885)	(2,110)	(2,320)
Shortage Reduction	4%	6%	8%	8%	8%	8%
Total Savings	**140**	**275**	**440**	**494**	**540**	**594**

Table 4B.2-14.
Projected Water Demands and Needs (Shortages) for Steam-Electric Users Considering up to a 7% Percent Demand Reduction by 2030

	Projections (acft/yr)					
	2010	***2020***	***2030***	***2040***	***2050***	***2060***
Bell[1]						
New Demand	0	3,490	3,995	4,699	5,558	6,605
Expected Savings	—	184	301	354	419	497
New Shortage	—	(3,490)	(3,995)	(4,699)	(5,558)	(6,605)
Shortage Reduction	—	5%	7%	7%	7%	7%
Bosque						
New Demand	4,193	5,879	6,729	7,914	9,360	11,124
Expected Savings	130	309	506	596	705	837
New Shortage	—	—	(229)	(1,414)	(2,860)	(4,624)
Shortage Reduction	—	—	69%	30%	20%	15%
Grimes						
New Demand	11,640	30,172	30,839	32,234	34,094	36,884
Expected Savings	360	1,588	2,321	2,426	2,566	2,776
New Shortage	—	(13,711)	(14,378)	(15,773)	(17,633)	(20,423)
Shortage Reduction	—	10%	14%	13%	13%	12%
Johnson						
New Demand	3,395	6,650	6,510	6,510	6,510	6,510
Expected Savings	105	350	490	490	490	490
New Shortage	(2051)	(5,306)	(5,166)	(5,166)	(5,166)	(5,166)
Shortage Reduction	5%	6%	9%	9%	9%	9%
Limestone						
New Demand	21,662	21,468	24,571	28,903	34,185	40,623
Expected Savings	670	1,130	1,849	2,176	2,573	3,058
New Shortage	—	—	—	(2,519)	(7,940)	(14,518)
Shortage Reduction	—	—	—	46%	24%	17%
Milam						
New Demand	12,125	11,875	11,625	11,625	14,880	14,880
Expected Savings	375	625	875	875	1,120	1,120
New Shortage	—	—	—	—	(880)	(880)
Shortage Reduction	—	—	—	—	56%	56%

Table 4B.2-14. (Concluded)

	Projections (acft/yr)					
	2010	***2020***	***2030***	***2040***	***2050***	***2060***
Nolan[1]						
New Demand	783	10,745	18,600	18,600	18,600	18,600
Expected Savings	24	566	1,400	1,400	1,400	1,400
New Shortage	(783)	(10,745)	(18,600)	(18,600)	(18,600)	(18,600)
Shortage Reduction	3%	5%	7%	7%	7%	7%
Robertson						
New Demand	15,315	16,988	28,935	33,823	44,750	46,797
Expected Savings	474	894	2,178	2,546	3,368	3,522
New Shortage	—	—	—	—	(10,908)	(12,963)
Shortage Reduction	—	—	—	100%	24%	21%
Somervell[1]						
New Demand	82,272	80,576	78,880	78,880	78,880	78,880
Expected Savings	2,545	4,241	5,937	5,937	5,937	5,937
New Shortage	(33,035)	(31,301)	(29,568)	(29,530)	(29,493)	(29,455)
Shortage Reduction	7%	12%	17%	17%	17%	17%
Total Savings	**4,683**	**9,887**	**15,857**	**16,800**	**18,578**	**19,637**

[1] – Conservation is not recommended since these represent new demands utilizing efficient technology.

Table 4B.2-15.
Projected Water Demands and Needs (Shortages) for
Mining Users Considering up to a 7% Percent Demand Reduction by 2030

	Projections (acft/yr)					
	2010	***2020***	***2030***	***2040***	***2050***	***2060***
Nolan						
New Demand	270	264	259	259	259	259
Expected Savings	8	14	19	19	19	19
New Shortage	(100)	(94)	(89)	(89)	(89)	(89)
Shortage Reduction	7%	13%	18%	18%	18%	18%
Stephens						
New Demand	8,454	8,862	8,897	9,112	9,322	9,623
Expected Savings	261	466	670	686	702	724
New Shortage	(7,360)	(7,768)	(7,803)	(8,018)	(8,228)	(8,529)
Shortage Reduction	3%	6%	8%	8%	8%	8%
Williamson						
New Demand	2,283	2,484	2,599	2,764	2,929	3,050
Expected Savings	71	131	196	208	220	230
New Shortage	(1,798)	(1,999)	(2,114)	(2,279)	(2,444)	(2,565)
Shortage Reduction	4%	6%	8%	8%	8%	8%
Total Savings	**340**	**611**	**885**	**913**	**941**	**973**

The Task Force report describes the above BMP methods and how they reduce water use; however, information regarding specific water savings and costs to implement conservation programs is generally unavailable. Conservation savings and costs are by nature facility-specific. Since industrial entities are presented on a county basis and are not individually identified, identification of specific water management strategies is not a reasonable expectation.

4B.2.3.3 Environmental Issues

The Task Force BMPs have been developed and tested through public and private sector research, and have been applied within the region. Such programs have been installed, and are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making changes to wildlife habitat. Thus, the proposed conservation practices do not have anticipated potential adverse effects, and may have potentially beneficial environmental effects.

4B.2.3.4 Engineering and Costing

The Brazos G RWPG recommends implementing water conservation for industrial users (manufacturing, steam-electric, and mining) with projected needs amounting to a 3 percent water demand reduction by 2010, 5 percent by 2020, and 7 percent from 2030 to 2060. The six counties in the Brazos G Area with projected manufacturing shortages can save up to 1,016 acft/yr in 2060. The ten counties in the Brazos G Area with projected steam-electric shortages can save up to 20,977 acft in 2060. The three counties in the Brazos G Area with projected mining shortages can save up to 973 acft in 2060. Costs to implement BMPs vary from site to site and the Brazos G RWPG recognizes that industries will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing industrial water conservation strategies.

4B.2.3.5 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Brazos G Area. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is public support for industrial water conservation and it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach greater potentials. The TWDB has industrial water conservation programs including presentations and workshops for utilities who wish to train staff to develop local programs including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of mining conservation.

This option is compared to the plan development criteria in Table 4B.2-16 and the option meets each criterion.

Table 4B.2-16.
Comparison of Industrial Water Conservation Option to Plan Development Criteria

Impact Category	*Comment(s)*
A. Water Supply	
1 Quantity	1. Manufacturing Firm Yield: up to 1,430 acft/yr Steam-Electric Firm Yield: up to 13,281 acft/yr Mining Firm Yield: up to 1,074 acft/yr
2. Reliability and Cost	2. Good reliability.
3. Cost	3. Cost: Highly variable based on BMP selected and facility specifics.
B. Environmental factors	
1. Instream flows	1. None or low impact.
2. Bay and Estuary Inflows	2. None or low impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
C. Impacts to State water resources	• No apparent negative impacts on water resources
D. Threats to agriculture and natural resources in region	• None
E. Recreational impacts	• None
F. Equitable Comparison of Strategies	• Standard analyses and methods used
G. Interbasin transfers	• None
H. Third party social and economic impacts from voluntary redistribution of water	• None
I. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions by reducing the rate of decline of local groundwater levels.
J. Effect on navigation	• None
K. Consideration of water pipelines and other facilities used for water conveyance	• None

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