Brazos G Regional Water Planning Area

Regional Water Plan

Volume I
Executive Summary
and Regional Water Plan

Prepared for

Brazos G Regional Water Planning Group

Prepared by

HDR Engineering, Inc.

In association with:
Capital City Consulting
Freese and Nichols, Inc.
R.W. Harden and Associates, Inc.
Hicks and Company, Inc.
Texas Agricultural Experiment Station
Texas Rural Water Association

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Executive Summary

Background

Senate Bill 1 was enacted by the 75th Session of the Texas Legislature in 1997. It specified that water plans be developed for regions of Texas and provided that future regulatory and financing decisions of the Texas Natural Resource Conservation Commission and the Texas Water Development Board (TWDB) be consistent with approved regional water plans. As stated in Senate Bill 1, the purpose of this region-based planning effort is to:

> "Provide for the orderly development, management, and conservation of water resources and preparation for and response to drought conditions in order that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare; further economic development; and protect the agricultural and natural resources of that particular region."

The TWDB is the state agency designated to coordinate the overall statewide planning effort. The Brazos G Region, which is comprised of all or portions of 37 counties (Figure ES-1), is one of the State's 16 planning regions established by the TWDB.

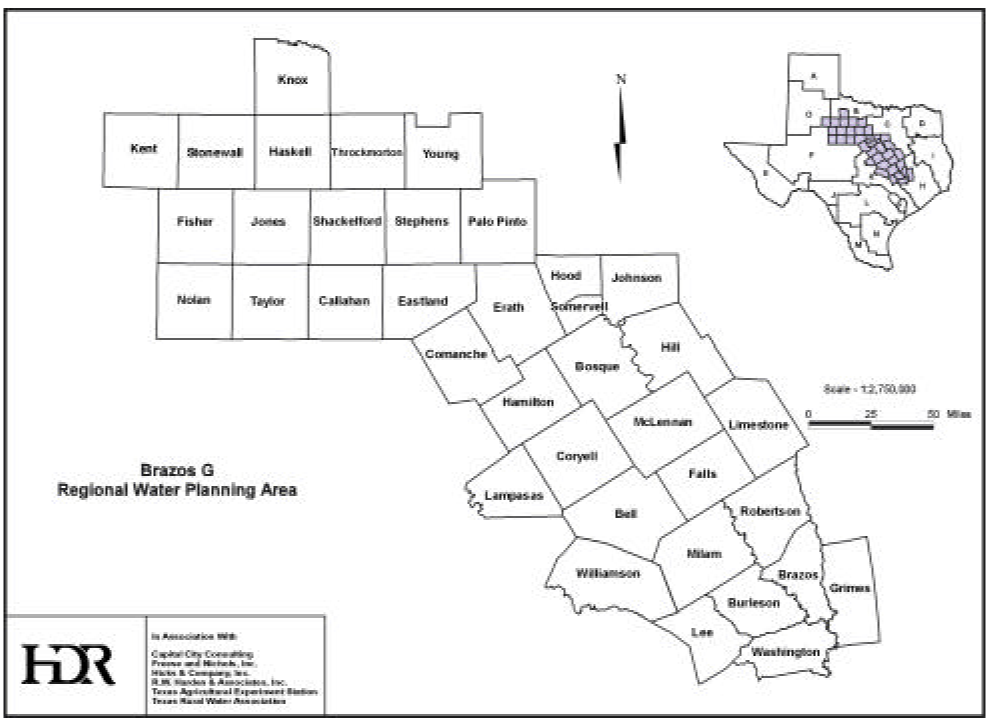

Figure ES-1. Brazos G Regional Water Planning Area

The 18-member Brazos G Regional Water Planning Group (RWPG) was appointed by the TWDB to represent a wide range of stakeholder interests and act as the steering and decision-making body of the regional planning effort. The RWPG designated the Brazos River Authority (BRA) as the administrative agency and principal contractor to receive a grant from the TWDB to develop the water plan. The RWPG selected HDR Engineering, Inc. as prime consultant for planning and engineering tasks for plan development.

The Brazos G RWPG consists of 18 individuals who represent the following 11 interests: the public, counties, municipalities, industries, agriculture, the environment, small businesses, electric-generating utilities, river authorities, water districts, and water utilities. Table ES-1 lists the interest groups and individuals of the RWPG.

Table ES-1.
Brazos G RWPG Members
(as of July 2000)

Interest Group	*Name*	*Entity*
Agriculture	Steve Sanford Chaunce Thompson	Farmer/Rancher Cattlemen
Counties	John Garth (Chairman) Tony Jones David Perdue, County Judge	County Government Brazos County Commissioners Court Knox County
Electric Generating Utilities	Ken Smith	TXU Electric
Environmental	Stephen L. Stark	Sportsmans Conservationists of Texas
Industry	Mark Bryson	Alcoa Aluminum
Municipalities	Truman Blum, Mayor John Hatchel Mike Morrison (Vice Chairman) Jim Nuse	City of Clifton City of Waco City of Abilene City of Round Rock
Public	Scott Mack, DDS	Dentist
River Authorities	Gary Gwyn, General Manager (Secretary/Treasurer)	Brazos River Authority
Small Business	Horace R. Grace	AMG Enterprises, Inc.
Water Districts	A.V. Jones, Jr. _____________	West Central Texas Municipal Water District Seat currently empty
Water Utilities	Kent Watson	Wickson Creek Special Utility District

The planning horizon to be used is the 50-year period from 2000 to 2050. This planning period allows for long-term forecast of the prospective water situation, sufficiently in advance of needs, to allow for appropriate management measures to be implemented. As required in Senate

Bill 1, the TWDB specified planning rules and guidelines (31 TAC 357.7 and 357.12) to focus the efforts and to provide for general consistency among the regions so that the regional plans can then be aggregated into an overall State Water Plan.

This executive summary and the accompanying *Regional Water Plan* convey water supply planning information, projected needs in the region, the RWPG proposed water plans to meet those needs, and other findings. The report is provided in three volumes. Figure ES-2 shows the contents of each volume.

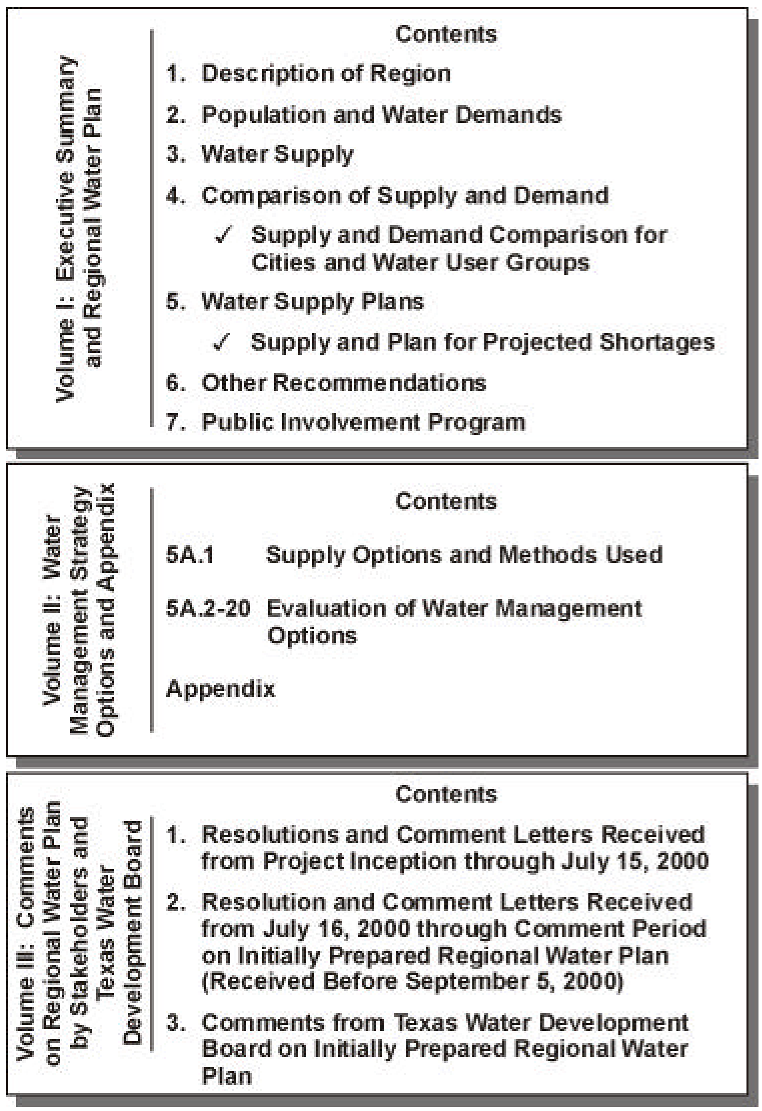

Figure ES-2. Plan Structure

Copies of the Regional Water Plan can be viewed on the Internet at <u>www.twdb.state.tx.us</u> or obtained by calling the Brazos River Authority at (254) 776-1441.

In addition to the work contained in the two volumes of the *Regional Water Plan*, other important products produced as part of the Brazos G planning effort include:

1. Population and water demand projections for the County-Other municipal use category. This work included projections for 328 entities (water districts, water supply corporations, and private water companies with more than 200 population). This work was submitted to the TWDB in support of requested revisions to their water demand projections. These projections can be viewed on the Brazos G website at www.twdb.state.tx.us.
2. Service area maps for water supply entities were developed on a GIS database for each of the 37 counties in the Brazos G Region.
3. A groundwater model of the Carrizo-Wilcox aquifer was developed and applied for several possible development plans. The model is specific to the portion of the aquifer underlying the Brazos G planning area with particular emphasis on the highly productive Simsboro formation within the aquifer. This work was performed by R.W. Harden and Associates and documented in the report *"Carrizo-Wilcox Ground Water Flow Model and Simulation Results,"* July 2000.
4. Streams and rivers located within the Brazos G Regional Water Planning Area were evaluated to identify segments which meet criteria for unique ecological value according to the regional water planning guidelines. This evaluation is described and documented in a report prepared by Hicks & Co., *"River and Stream Segments of Unique Ecological Value in the Brazos G Regional Water Planning Area,"* January 2000.
5. A groundwater model of the Brazos Alluvium Aquifer was developed and used to evaluate the potential for conjunctive use of the aquifer with surface water from the Brazos River. The model is specific to the area of the Brazos Alluvium Aquifer between the City of Calvert and State Highway 21 in Brazos Region G, and evaluates the possible response of the aquifer system to a proposed conjunctive use water supply project. The work is documented in the report *"Brazos River Alluvium Groundwater Model and Conjunctive Use Analysis,"* January 2001.
6. A hydrogeologic investigation was conducted in a portion of the Seymour Aquifer in Jones County, Texas, to assess the possibility for use of the groundwater as a source of drought contingency water supply, and to characterize the aquifer for potential utilization in an aquifer storage and recovery project. The work is documented in the report *"Seymour Aquifer Hydrogeologic Investigation Report, Jones County, Texas,"* January 2001.

Description of the Region

The Brazos G Region can be described by a single word—**Diverse**. From the piney woods of Brazos and Grimes Counties to the rolling plains of Nolan County; from sparsely populated Stonewall County to Williamson County, often listed as the fastest growing county in the nation; from the prodigious Carrizo-Wilcox Aquifer in the southeast to meager dribbles of windmills in Shackelford County; from 44 inches of annual rainfall in the east to 24 Inches annually in the west (in a good year); from the Chisholm Trail through Stephens County to the NAFTA trail known as Interstate 35. These diverse characteristics make for a wide variation in water supplies, demands, and availability of affordable options to meet needs.

Population and Water Demand Projections

In July 1998, the TWDB published population and water demand projections[1] for each county in the state. In the Brazos G Region, population projections were developed for 133 cities and Census-Designated Place names (CDP) with a population greater than 500. To account for people living outside the cities, projections were also developed for a 'county-other' category for each county. Requests for revisions to the population and municipal water demand projections for were forwarded to the TWDB and in most cases were adopted.

Rural Population and Water Demand
Population and water demand projections were prepared for 328 community water systems that serve rural areas outside cities in order to better estimate the County-Other use category.

Water Demand Projections

Figure ES-3 illustrates population growth in the entire Brazos G Regional Water Planning Area (RWPA) for 1900 to 1998 and projected growth for 2010 to 2050.

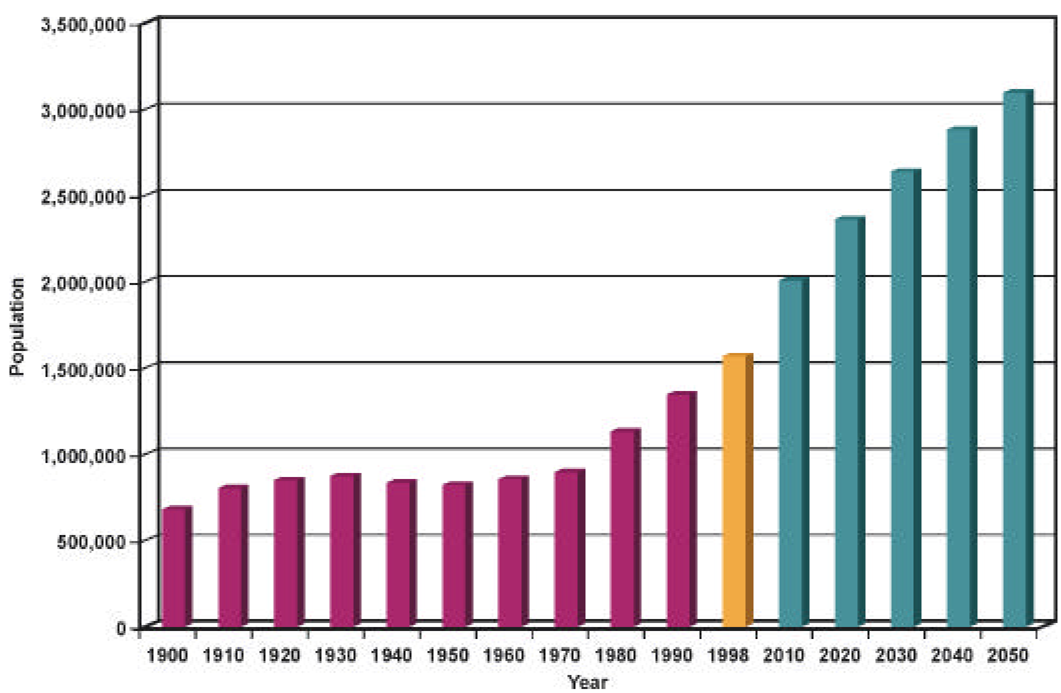

Figure ES-3. Historical and Projected Brazos G RWPA Population

[1] The population and water demand projections were developed in consultation with the Texas Parks and Wildlife Department and Texas Natural Resources Conservation Commission. The completed projections are referred to as the 1997 Consensus Population and Water Demand Projections.

Population trends may be further understood by dividing the planning region into three subregions: the northwestern Rolling Plains, the central IH-35 Corridor, and the southeastern Lower Basin. Figure ES-4 shows historical population growth in the three sub-regions from 1900 to 1998 and projected growth from 2010 to 2050. Projected growth is greatest in the IH-35 Corridor.

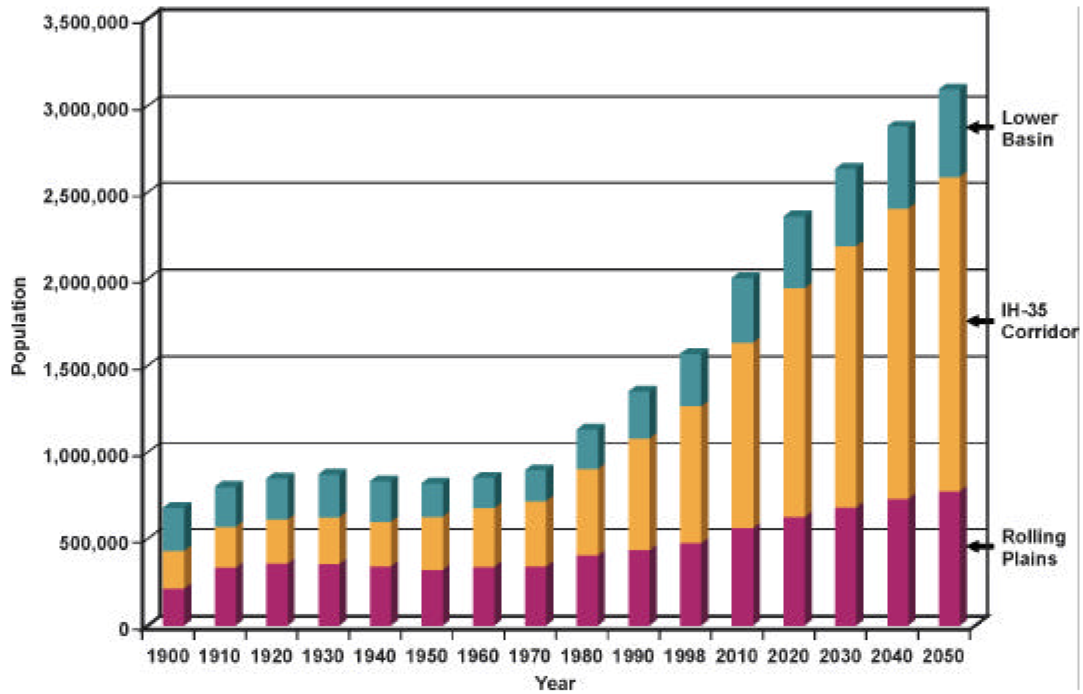

Figure ES-4. Historical and Projected Population by Sub-Region

Water Demand Projections

Water demand projections have been compiled for six categories of water use: (1) Municipal, (2) Manufacturing, (3) Steam-Electric Cooling, (4) Mining, (5) Irrigation, and (6) Livestock.

> **Water User Groups**
> Each of these consumptive water uses is termed a "water user group" in SB 1 lingo. Incorporated cities and County-Other category are water user groups within the Municipal Use category. Water demand projections and supplies have been estimated for all water user groups.

Total water use for the region is projected to increase from 725,766 acft in 2000 to 1,034,262 acft in 2050, a 42.5 percent increase. The trend in total water use is shown in Figure ES-5. The six types of water use as percentages of total water use are shown for 2000 and

2050 in Figure ES-6. Municipal, manufacturing, and steam-electric water use as percentages of the total water use increase from 2000 to 2050, while mining, irrigation, and livestock water use decrease as percentages of the total.

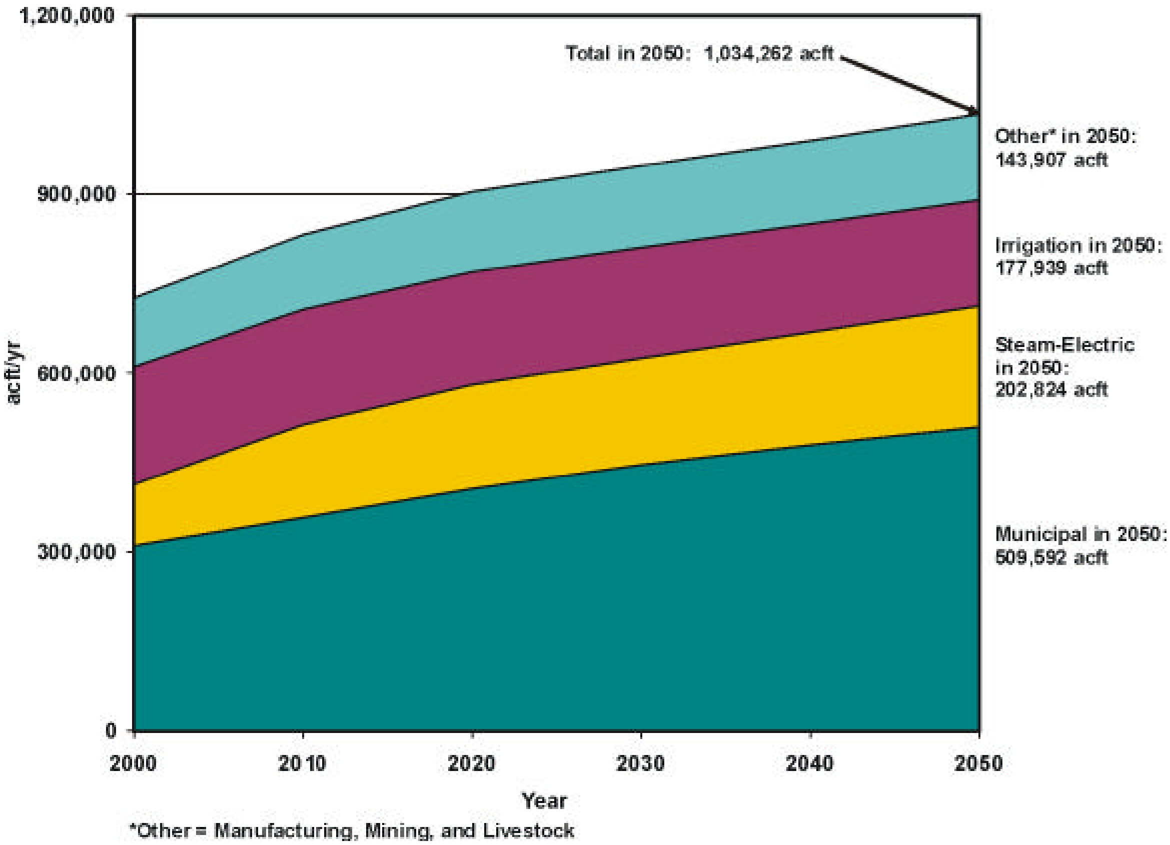

Figure ES-5. Projected Total Water Demand

Municipal Use and Water Conservation

The 64 percent projected increase in municipal water demand over the 50-year planning horizon is lower than the projected population increase of 85 percent due to expected savings in per capita water use resulting from water conservation.

Irrigation Water Use

Irrigation water demand projections were last updated in 1993 using 1990 data. The projections do not reflect the changes in farm policy that resulted from passage of the 1996 Farm Bill. Irrigation water demand is projected to decline 9.8 percent from 2000 to 2050. This is attributable to technological advances in irrigation conservation techniques as well as projected reduction in irrigated land.

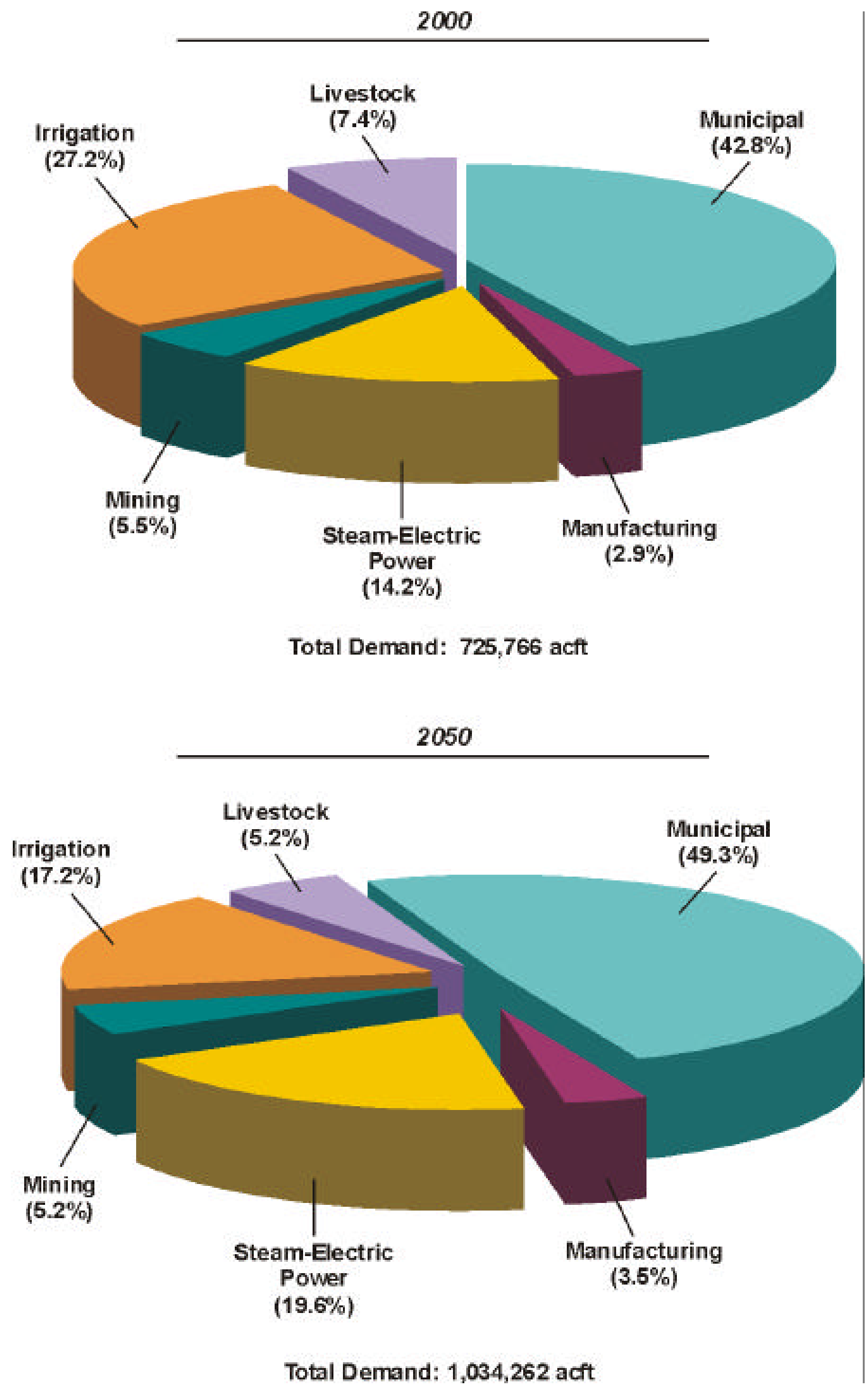

Figure ES-6. Total Water Demand

Water Supply

Surface Water Supplies

Streamflow in the Brazos River and its tributaries, along with reservoirs in the Brazos River Basin, comprise a vast supply of surface water in the Brazos G Region. Diversions and use of this surface water occurs throughout the entire region with over 1,000 water rights currently issued. However, the supply of surface water varies greatly through the region due to the large variation in rainfall and a correspondingly large variation in evaporation rates. The principal tributaries to the Brazos River in the planning area are the Clear Fork, the Double Mountain Fork, the Salt Fork, Bosque River, Little River, Navasota River, Little Brazos River and Yegua Creek. Major water supply reservoirs are owned by the BRA (three in the planning region), U.S. Army Corps of Engineers (nine in the region), West Central Texas MWD, the City of Abilene, and Texas Utilities. The western part of the region is heavily dependent on surface water sources, partly due to the absence of potable-quality groundwater.

Many entities within the Brazos G Region obtain surface water through water supply contracts. The BRA is the largest provider of water supply contracts in the Brazos G Region with 661,901 acft/yr permitted from its system of reservoirs in the Brazos River Basin. Run-of-the-river and small municipal water rights with storage provide 35,443 acft/yr of reliable water. Total supply from all surface water sources in year 2000 is shown below in Table ES-2.

Table ES-2
Total Supply from all Surface Water Sources*

Municipal	538,256 acft/yr
Manufacturing	7,412 acft/yr
Steam-Electric	236,697 acft/yr
Mining	6,663 acft/yr
Irrigation	116,026 acft/yr
Livestock	35,937 acft/yr
Total	940,991 acft/yr
*Note: Supply listed is based on total supply available to water rights and is not limited by facility capacity constraints.	

Groundwater Supplies

Fifteen aquifers underlie parts of the Brazos G planning region and have a combined reliable yield of about 559,437 acft/yr. The Seymour Aquifer supplies significant quantities of water in the western part of the region. Other aquifers that are depended on in the western part of the region are the Dockum and the Edwards-Trinity. The Trinity and Edwards-BFZ are heavily relied upon in the I-35 corridor and to the west. Both of these aquifers are being pumped in excess of their estimated sustainable yield in some counties. In the eastern part of the region, the Carrizo-Wilcox is a prolific water supply with lesser amounts pumped from the Queen City, Sparta, and Brazos River Alluvium.

Water Quality

Natural salt pollution has been recognized as the most serious and widespread water quality problem in the Brazos River Basin. No other pollution source, man-made or natural, has had the impact of the natural salt sources located in the upper basin. Due to these water quality issues, some sources of water—particularly from Lake Whitney, Lake Granbury, and Possum Kingdom Reservoir—may limit their availability for some uses and require higher cost, advanced treatment. As the Brazos River flows to the Gulf, inflows from tributaries decrease the concentration of dissolved minerals, which in turn improves the quality of water.

Supply and Demand Comparison

A comparison of supply and demand for all use categories in the region would show a surplus of about 500,000 acft in year 2050. Much of this surplus is attributable to supplies available from the Carrizo-Wilcox Aquifer. This regional comparison masks shortages that are projected to occur to individual water supply entities and water user groups. Even in counties that have projected surpluses, there are entities that do not have sufficient supply to meet projected needs. This even occurs in Bell County – a county that has significant water resources to meet 50-year needs.

Constraints on Water Supply

Water supplies are also affected by contractual arrangements and infrastructure constraints. Expiring contracts, insufficient well capacity, inadequate intakes, pump stations, and pipelines - each of these supply constraints was taken into account in estimating water supplies available to municipal water user groups. Consequently, the water supply listed for a given city may be less than the quantity in their water purchase contract or water right.

Table ES-3 lists those counties with a projected shortage in the planning horizon in one or more of the six water use categories. There are 30 counties on the list. Table ES-3 (at the end of this Executive Summary) are organized by county and information on each municipality and water use category in the county is listed. The tables can be examined for each county to determine which water user group has a projected shortage and the amount of the shortage.

Table ES-3.
Counties with Projected Water Shortages

Bell County	Hood County	Robertson County
Bosque County	Johnson County	Shackelford County
Brazos County	Jones County	Somervell County
Callahan County	Knox County	Stephens County
Comanche County	Lampasas County	Taylor County
Coryell County	Lee County	Throckmorton County
Eastland County	Limestone County	Williamson County
Erath County	McLennan County	Young County
Fisher County	Milam County	
Haskell County	Nolan County	
Hill County	Palo Pinto County	

There are seven counties with no shortages in any water use category: (1) Burleson, (2) Falls, (3) Grimes, (4) Hamilton, (5) Kent, (6) Stonewall, and (7) Washington.

Water Demand and Supply Comparison Observations and Findings

Municipal and Industrial

1. Water needs in the next 50 years are created, for the most part, by population growth and natural salt pollution, and to a lesser extent by groundwater depletion and declining reservoir yields.
2. High growth along I-35, particularly in Williamson and Johnson Counties, is creating water supply needs. Bell, McLennan, and Hill Counties, as well as counties just west of I-35, overlay the Trinity Aquifer and are experiencing rapid growth – thereby straining modest groundwater supplies.
3. Groundwater will continue to be a major water supply in much of the region and available supply has been allocated to meet demands – implicit in this is a management strategy to fully develop groundwater sources.
4. The Carrizo-Wilcox Aquifer east of I-35 provides adequate long-term supply to the overlying counties; in many cases, new facilities are needed to use this supply.
5. Slower economic growth, and implementation of previous long-term planning, results in fewer long-term municipal needs in the upper Brazos G Region.
6. Many of the needs can be met with contract amendments by extending existing supplies to new customers, but may require new conveyance facilities.
7. Water availability in a county does not mean that all local water utilities have adequate water supply - infrastructure and contract limitations create needs in some areas.
8. The biggest challenge to many communities is financing construction of conveyance and treatment facilities, rather than securing new water sources.
9. Deregulation of electric generation is prompting construction of merchant power plants and water supplies must be found to meet these prospective significant water demands.
10. Demand/supply comparisons show where water is available, but water quality (TDS and chlorides) influences whether water is usable or economically treatable. Counties where this is of concern include Jones, Johnson, McLennan, Palo Pinto, Haskell, Hood, Young, Bosque, Hill and possibly others.

Irrigation and Livestock

1. Agriculture irrigation demands are heavily influenced by government farm policy and long-term projections of agricultural water use have uncertain accuracy.
2. Irrigation has increased over the past ten years in Knox and Haskell Counties, in the Blacklands, and along the Brazos River. Irrigation has decreased in Comanche, Eastland, and Erath Counties due largely to transfers of peanut production quota to West Texas as a result of the 1996 Farm Bill.
3. With farm economics and policy changes, Trinity Aquifer groundwater and Leon River surface water could become a limiting resource for renewed agricultural production.
4. Irrigation shortages are typical during dry years for areas using deficit irrigation practices, and little, if any, water management changes are indicated.
5. Projected decreases in irrigation water demand are arguable due to the uncertainty in agricultural profitability, federal farm programs, world trade, and issues of food safety and security.
6. Agricultural interests believe that water supplies in excess of projected irrigation needs, particularly in the Carrizo-Wilcox aquifer area, should not be regarded as available for transfer to municipal water demands.

Water Supply Strategies to Meet Needs

The following water management strategies were identified by the RWPG as potentially feasible to meet shortages. These strategies were evaluated by the consultant team and compared to criteria adopted by the RWPG. Section 5A in Volume 2 contains subsections discussing each of these possible strategies.

Water Management Strategies	
Report Section (Volume 2)	**Water Management Strategy and Description**
5A.2	**Advanced Water Conservation** (implement accelerated use of various water conservation techniques to achieve water savings above what is already included in the Consensus Water Plan projections
5A.3	**Wastewater Reuse** (use highly treated wastewater treatment plant effluent to meet non-potable water needs, including landscape irrigation and industrial use
5A.4	**Expanded Use of Existing Supplies** (methods to increase supplies from existing sources through systems operation, conjunctive use, and other low cost methods). Possible projects include: • Coordinated use of Lake Leon with local groundwater supplies • Coordinated use of Fort Phantom Hill and Hubbard Creek Reservoirs • Coordinated use of Lakes Sweetwater, Trammel, and Oak Creek • Other projects
5A.5	**Lake Whitney Reallocation** (reallocation of storage volume currently dedicated to hydropower and use for water supply purposes)
5A.6	**Voluntary Redistribution** (the purchase or lease of water supply from an entity that has water supply in excess of long-term or interim needs)
5A.7	**Enhancement of Reservoir Yields** (methods to augment the supply of existing facilities through configuration changes, new supply sources, or other). Possible projects include: • Increase storage in Lake Leon by raising pool level • Divert flows from California Creek into Lake Stamford • Divert flows from Sweetwater Creek into Lake Sweetwater • Increase storage in Lake Fort Phantom Hill • Supplement Lake Fort Phantom Hill with groundwater • Other projects
5A.8	**Control of Naturally Occurring Chlorides** (water quality improvement, not water supply) • Brine Recovery with deep well injection disposal • Brine Recovery with evaporation ponds disposal • Other projects
5A.9	**Brush Control and Range Management** (increase deep percolation and discharge to streams by removing unwanted brush) • Mechanical Brush Control • Chemical Brush Control • Prescribed Burning • Managed Grazing
5A.10	**Weather Modification** (cloud seeding to increase precipitation frequency and intensity)
5A.11	**Desalination** (treatment of brackish water to remove minerals with resulting potable water) • Desalination of Lake Whitney Water

	• Desalination of Lake Granbury Water • Brackish Groundwater Desalination • Brackish Groundwater Desalination for steam-electric cooling
5A.12	**Aquifer Storage and Recovery** (use of an aquifer to store water during average and wet years for later use during drought) • Seymour Aquifer development – Jones County
5A.13	**Cancellation of Water Rights** (cancellation of unused surface water rights; RWPG voted this as "not feasible")
5A.14	**New Reservoirs** (construction of major reservoirs). Possible projects include: • Breckenridge Reservoir • South Bend Reservoir • Paluxy Reservoir • Lake Bosque • Millican Reservoir – Panther Creek Site • Millican Reservoir – Bundic Site • Little River Reservoir • Other sites
5A.15	**Off-Channel Reservoirs** (construction of smaller reservoirs on tributary streams with lower environmental impact, lower cost dam, and usually with pump-over of supplies from a larger stream). Possible projects include: • Meridian Off-Channel Reservoir • Groesbeck Off-Channel Reservoir • Somervell County Off-Channel Reservoir • Peach Creek Lake Off-Channel Reservoir • Little River Off-Channel Reservoir • Other sites
5A.16	**Regional Surface Water Systems to Augment Declining Groundwater Supplies** (provide surface water sources to areas dependent on declining groundwater supplies). Possible projects include: • Bosque County Regional Surface Water Supply from Lake Whitney • Lake Granbury Supply to Johnson County • Regional Surface Water Supply to Williamson County from Lake Travis • Other projects
5A.17	**Carrizo-Wilcox Aquifer Development** (further develop and utilize the Carrizo-Wilcox Aquifer) • Additional Development of Carrizo-Wilcox Aquifer for Brazos County • Carrizo-Wilcox Aquifer Supply for Williamson County
5A.18	**Water Trades in the Brazos River Basin** (develop new water sources in Region G to meet existing downstream demands in Region H, thereby freeing supplies upstream in existing BRA reservoirs for Brazos G needs)
5A.19	**Conjunctive Use in the Brazos River Alluvium** (manage the surface water and groundwater supplies in the alluvium to increase the overall yield of the system)
5A.20	**Interconnection of Regional and Community Water Systems** (use larger cities' systems or other facilities more fully and assist smaller communities meet their needs). Possible projects include: • Interconnection of Community Systems in Bosque County • Use of Oryx/Kerr-McGee pipeline from Possum Kingdom Reservoir to supply surrounding rural systems • Interconnect City of Abilene system with City of Hamlin • Interconnect City of Waco system with neighboring communities • Interconnect Central Texas WSC with Salado WSC • Other projects

Water Plan Findings and Recommendations

Table ES-4 summarizes findings and recommendations for every water user group. The table also lists each municipality and water user group by county. For municipal and county-other, population is listed for year 2000 and 2030. Water demands are also listed for year 2000 and 2030. Shortages are listed for year 2030 along with recommended actions to meet these near-term shortages. Long-term shortages (i.e., at year 2050) and actions to meet long-term shortages are contained in the Section 5 water plans for each county.

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Bell County	***Section 2.2***		***Section 2.3***		***Section 4.2.1***		
BARTLETT (P)	883	1,377	173	293	none		
BELTON	16,789	26,008	2,727	5,390	none		
FORT HOOD (P)	17,021	17,021	4,766	4,766	(3,098)	I.S.	Purchase water from Bell County WCID #1 (See Section 5B.1.13)
HARKER HEIGHTS	18,683	29,134	3,997	6,037	none		
HOLLAND	1,447	2,096	178	376	(87)	I.S.	Purchase/lease water through voluntary redistribution - Lake Belton (See Section 5B.1.4)
KILLEEN	88,787	136,343	11,935	27,185	none		
LITTLE RIVER-ACADEMY	1,623	2,343	255	486	(127)	I.S.	Purchase water from City of Temple (See Section 5B.1.6)
MORGANS POINT RESORT	2,556	4,112	429	875	(584)	I.S.	Purchase water from City of Temple (See Section 5B.1.7)
NOLANVILLE	2,408	3,716	297	666	none		
ROGERS	1,279	1,913	179	343	none		
SALADO(CDP)	1,601	2,792	755	1,220	(228)	#1,#3	Implement regional water system to utilize BRA contract (See Section 5B.1.10)
TEMPLE	58,447	90,029	13,094	21,178	none		
TROY	1,676	2,507	235	449	(255)	I.S.	Purchase water from nearby City of Temple (See Section 5B.1.12)
COUNTY-OTHER	34,150	49,649	8,369	7,836	none		
MANUFACTURING	-	-	4,040	7,620	(7,315)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.1.15)
STEAM-ELECTRIC	-	-	0	11,200	(11,200)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.1.16)
MINING	-	-	155	166	none		
IRRIGATION	-	-	745	715	none		
LIVESTOCK	-	-	1,119	1,119	none		

(P) Indicates City is in multiple counties; projections shown are for this county only.
* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Bosque County	*Section 2.2*		*Section 2.3*		*Section 4.2.2*		
CLIFTON	3,557	4,599	625	773	none		
MERIDIAN	1,520	1,989	293	337	(218)	I.S.	Meridian off-channel reservoir (See Section 5B.2.2)
VALLEY MILLS (P)	1,090	1,149	155	140	(77)	I.S.	Purchase water from City of Clifton (See Section 5B.2.3)
WALNUT SPRINGS	804	819	93	79	(41)	I.S.	Meridian off-channel reservoir (See Section 5B.2.4)
COUNTY-OTHER	16,321	17,894	2,010	1,935	(992)	I.S.	Merdian off-channel reservoir; purchase water from City of Clifton; purchase/lease water through voluntary redistribution from Lake Whitney and provide through regional system (See Section 5B.2.5)
MANUFACTURING	-	-	857	1,137	(704)	I.S.	Purchase/lease of water through voluntary redistribution from Lake Whitney (See Section 5B.2.6)
STEAM-ELECTRIC	-	-	0	5,600	(5,600)	I.S.	Purchase/lease of water through voluntary redistribution from Lake Whitney (See Section 5B.2.7)
MINING	-	-	301	428	(136)	I.S.	Purchase/lease of water through voluntary redistribution from BRA system (See Section 5B.2.8)
IRRIGATION	-	-	1,116	1,065	none		
LIVESTOCK	-	-	1,160	1,160	none		
Brazos County	*Section 2.2*		*Section 2.3*		*Section 4.2.3*		
BRYAN	64,400	97,719	12,042	15,984	none		Further development of Carrizo-Wilcox Aquifer (See Section 5B.3.1)
COLLEGE STATION	28,322	73,005	12,063	22,057	(6,381)	#2,#3	Further development of Carrizo-Wilcox Aquifer (See Section 5B.3.2)
TEXAS A&M	43,000	43,000	8,590	8,590	none		
COUNTY-OTHER	16,841	30,956	2,409	3,601	none		
Wickson Creek SUD	part of County-Other		part of County-Other			#3	Delivery facilities (See Section 5B.3.4.1)
MANUFACTURING	-	-	194	262	none		
STEAM-ELECTRIC	-	-	5,000	5,000	none		
MINING	-	-	27	30	none		
IRRIGATION	-	-	9,399	8,103	none		
LIVESTOCK	-	-	1,547	1,547	none		
Burleson County	*Section 2.2*		*Section 2.3*		*Section 4.2.4*		
CALDWELL	3,609	4,402	768	838	none		
SOMERVILLE	1,596	2,316	247	306	none		
COUNTY-OTHER	9,709	11,389	1,181	1,213	none		
MANUFACTURING	-	-	131	171	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	29	15	none		
IRRIGATION	-	-	6,612	5,819	none		
LIVESTOCK	-	-	1,318	1,318	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Callahan County	Section 2.2		Section 2.3		Section 4.2.5		
BAIRD	1,706	1,710	327	287	(149)	I.S.	Purchase water from City of Abilene; Reuse; Additional conservation (See Section 5B.5.1)
CLYDE	3,146	3,296	448	402	none		
CROSS PLAINS	1,074	900	227	165	none		
COUNTY-OTHER	5,934	5,983	698	616	none		
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	193	119	none		
IRRIGATION	-	-	651	620	none		
LIVESTOCK	-	-	884	884	none		
Comanche County	Section 2.2		Section 2.3		Section 4.2.6		
COMANCHE	4,107	4,346	695	643	none		
DELEON	2,195	2,323	344	315	none		
COUNTY-OTHER	6,886	7,288	863	785	none		
MANUFACTURING	-	-	28	43	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	87	92	none		
IRRIGATION	-	-	50,102	48,567	(13,475)	I.S.	Additional conservation through system conversion and irrigation scheduling; brush control; weather modification; unmet demands of 6,875 acft (Section See Section 5B.6.7)
LIVESTOCK	-	-	3,181	3,181	none		
Coryell County	Section 2.2		Section 2.3		Section 4.2.7		
COPPERAS COVE	33,900	71,505	4,557	8,250	(426)	I.S.	Purchase water from Bell County WCID #1 (See Section 5B.7.1)
FORT GATES	923	976	167	156	none		
FORT HOOD (P)	18,559	18,559	4,511	4,033	(2,365)	I.S.	Purchase water from Bell County WCID #1 (See Section 5B.7.3)
GATESVILLE	15,638	39,289	3,311	7,394	(6,102)	#1, I.S.	Renew BRA Contract; Purchase water from Bell County WCID #1; (See Section 5B.7.4)
COUNTY-OTHER	14,478	16,478	1,959	1,999	(541)	I.S.	Purchase water from Bell County and/or McLennan County entity (See Section 5B.7.5)
MANUFACTURING	-	-	9	15	(15)	I.S.	Reallocate surplus municipal supply (See Section 5B.7.6)
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	104	116	none		
IRRIGATION	-	-	277	163	none		
LIVESTOCK	-	-	1,472	1,472	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Eastland County	Section 2.2		Section 2.3		Section 4.2.8		
CISCO	3,802	3,509	669	538	(185)	I.S.	Battle Creek diversion; Reuse (See Section 5B.8.1)
EASTLAND	3,593	3,332	1,159	970	none		
GORMAN	1,287	1,188	180	141	none		
RANGER	2,800	2,557	643	521	none		
RISING STAR	862	752	97	68	none		
COUNTY-OTHER	5,596	5,219	991	899	none		
MANUFACTURING	-	-	16	18	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	180	86	none		
IRRIGATION	-	-	12,580	12,640	(7,423)	I.S.	Additional conservation through system conversion and irrigation scheduling; brush control; weather modification; Unmet demands of 5,278 acft (Section See Section 5B.8.10)
LIVESTOCK	-	-	1,144	1,144	none		
Erath County	Section 2.2		Section 2.3		Section 4.2.9		
DUBLIN	3,241	3,500	472	435	none		
STEPHENVILLE	16,060	23,311	3,238	4,178	(1,538)	I.S.	Purchase water from Upper Leon MWD (See Section 5B.9.2)
COUNTY-OTHER	13,527	18,254	1,602	1,815	none		
MANUFACTURING	-	-	95	113	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	0	0	none		
IRRIGATION	-	-	9,563	9,150	none		
LIVESTOCK	-	-	7,400	7,400	none		
Falls County	Section 2.2		Section 2.3		Section 4.2.10		
LOTT	866	847	108	89	none		
MARLIN	6,947	8,225	1,338	1,419	none		No shortage; Brushy Creek Reservoir; part of Big Creek Watershed Project (See Section 5B.10.2)
ROSEBUD	1,826	2,224	237	244	none		
COUNTY-OTHER	9,375	10,867	1,177	1,195	none		
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	150	88	none		
IRRIGATION	-	-	6,218	5,636	none		
LIVESTOCK	-	-	1,368	1,368	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Fisher County	***Section 2.2***		***Section 2.3***		***Section 4.2.11***		
ROBY	630	601	68	54	(54)	I.S.	Renew existing contract with City of Sweetwater (See Section 5B.11.1)
ROTAN	1,909	1,720	276	210	none		
COUNTY-OTHER	2,303	2,076	508	433	none		
MANUFACTURING	-	-	144	191	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	449	358	none		
IRRIGATION	-	-	2,514	2,295	none		
LIVESTOCK	-	-	728	728	none		
Grimes County	***Section 2.2***		***Section 2.3***		***Section 4.2.12***		
ANDERSON	469	577	78	85	none		
NAVASOTA	6,763	8,527	901	955	none		
COUNTY-OTHER	14,313	20,710	1,799	2,197	none		
MANUFACTURING	-	-	280	391	none		
STEAM-ELECTRIC	-	-	10,000	20,000	none		
MINING	-	-	273	219	none		
IRRIGATION	-	-	125	125	none		
LIVESTOCK	-	-	1,933	1,933	none		
Hamilton County	***Section 2.2***		***Section 2.3***		***Section 4.2.13***		
HAMILTON	2,766	2,327	626	456	none		
HICO	1,312	1,104	253	183	none		
COUNTY-OTHER	3,264	2,746	422	294	none		
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	0	0	none		
IRRIGATION	-	-	1,692	1,624	none		
LIVESTOCK	-	-	1,811	1,811	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Haskell County	Section 2.2		Section 2.3		Section 4.2.14		
HASKELL	3,478	3,852	549	526	(526)	#1, I.S.	Renew existing contract with NCTMWD; Reuse (See Section 5B.14.1)
RULE	843	874	133	120	none		
STAMFORD (P)	39	44	11	11	none		
COUNTY-OTHER	2,376	2,527	303	325	none		
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	700	3,000	(1,709)	I.S.	California Creek diversion (See Section 5B.14.6)
MINING	-	-	95	12	none		
IRRIGATION	-	-	21,656	19,782	none		
LIVESTOCK	-	-	789	789	none		
Hill County	Section 2.2		Section 2.3		Section 4.2.15		
HILLSBORO	7,234	8,209	1,296	1,297	none		
HUBBARD	1,604	1,820	207	198	none		
ITASCA	1,545	1,754	223	217	none		
WHITNEY	1,673	1,803	189	170	none		
COUNTY-OTHER	17,168	19,677	2,255	2,270	none		
MANUFACTURING	-	-	72	102	(56)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.15.6)
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	140	141	none		
IRRIGATION	-	-	281	275	none		
LIVESTOCK	-	-	1,351	1,351	none		
Hood County	Section 2.2		Section 2.3		Section 4.2.16		
GRANBURY	8,281	26,296	1,389	4,367	(2,905)	#3	Increase conveyance and treatment capacity - SWATS (See Section 5B.16.1)
TOLAR	532	464	52	37	none		
COUNTY-OTHER	32,802	51,269	3,506	4,953	none		
MANUFACTURING	-	-	11	19	none		
STEAM-ELECTRIC	-	-	4,500	6,700	none		
MINING	-	-	135	102	none		
IRRIGATION	-	-	6,797	6,423	none		
LIVESTOCK	-	-	522	522	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Johnson County	***Section 2.2***		***Section 2.3***		***Section 4.2.17***		
ALVARADO	3,266	5,718	426	692	(72)	#1, I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.1)
BRIAR OAKS	565	584	71	62	(36)	I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.2)
BURLESON (P)	19,083	34,307	2,287	3,113	(783)	I.S.	Purchase water from Tarrant Regional MWD (See Section 5B.17.3)
CLEBURNE	26,147	42,688	5,301	7,698	none		
GODLEY	584	621	95	88	(60)	I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.5)
GRAND VIEW	1,511	1,958	200	222	(160)	I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.6)
JOSHUA	4,761	9,981	416	671	(29)	#3	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.7)
KEENE	5,582	9,559	773	1,299	(1,149)	I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.8)
MANSFIELD (P)	852	1,371	136	172	none		
RIO VISTA	611	629	65	55	(34)	I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.10)
VENUS	795	1,090	292	383	(323)	I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.11)
COUNTY-OTHER	73,879	100,626	89,887	11,476	(7,054)	#3	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.12)
MANUFACTURING	-	-	1,134	1,803	(1,309)	I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.13)
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	335	130	(33)	I.S.	Increase conveyance and treatment capacity - SWATS (See Section 5B.17.15)
IRRIGATION	-	-	0	0	none		
LIVESTOCK	-	-	2,582	2,582	none		
Jones County	***Section 2.2***		***Section 2.3***		***Section 4.2.18***		
ABILENE (P)	884	1,577	206	360	none		
ANSON	2,772	3,236	497	504	none		
HAMLIN	2,914	3,428	685	714	(714)	#3	Purchase water from the Cites of Abilene and Anson (See Section 5B.18.3)
HAWLEY	582	463	155	111	none		
STAMFORD (P)	4,020	4,746	1,126	1,191	(372)	I.S.	Diversion from California Creek; Reuse; Additional conservation (See Section 5B.18.5)
COUNTY-OTHER	6,220	7,192	620	598	(93)	I.S.	Purchase water from Cities of Abilene, Anson, or Stamford (See Section 5B.18.6)
MANUFACTURING	-	-	331	380	(380)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.18.7)
STEAM-ELECTRIC	-	-	2,340	10,324	(3,824)	I.S.	Purchase water from City of Abilene (See Section 5B.18.8)
MINING	-	-	289	208	none		
IRRIGATION	-	-	3,822	3,490	none		
LIVESTOCK	-	-	860	860	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Kent County	*Section 2.2*		*Section 2.3*		*Section 4.2.19*		
JAYTON	589	493	157	115	none		
COUNTY-OTHER	390	326	50	34	none		
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	736	88	none		
IRRIGATION	-	-	646	593	none		
LIVESTOCK	-	-	319	319	none		
Knox County	*Section 2.2*		*Section 2.3*		*Section 4.2.20*		
BENJAMIN	234	263	105	108	none		
KNOX CITY	1,507	1,694	241	235	(235)	#1	Renew existing contract with NCTMWD (See Section 5B.20.2)
MUNDAY	1,609	1,808	299	294	(294)	#1	Renew existing contract with NCTMWD (See Section 5B.20.3)
COUNTY-OTHER	1,555	1,747	263	256	none		
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	20	14	none		
IRRIGATION	-	-	31,529	29,263	(2,199)	I.S.	Additional conservation through system conversion; brush control; weather modification (See Section 5B.20.8)
LIVESTOCK	-	-	428	428	none		
Lampasas County	*Section 2.2*		*Section 2.3*		*Section 4.2.21*		
LAMPASAS	7,647	11,954	1,670	2,544	(544)	#3	Increase conveyance and treatment capacity; Reuse (See Section 5B.21.1)
LOMETA	723	774	126	117	none		
COUNTY-OTHER	8,415	11,752	1,429	1,729	none		
MANUFACTURING	-	-	114	131	(108)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.21.4)
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	188	179	none		
IRRIGATION	-	-	178	172	none		
LIVESTOCK	-	-	984	984	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Lee County	***Section 2.2***		***Section 2.3***		***Section 4.2.22***		
GIDDINGS	4,476	5,746	1,369	1,597	(337)	#2	Further development of Carrizo-Wilcox Aquifer (See Section 5B.22.1)
LEXINGTON	1,052	1,351	238	271	none		
COUNTY-OTHER	8,605	11,047	1,619	1,819	none		
MANUFACTURING	-	-	6	9	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	30	25,005	none		
IRRIGATION	-	-	275	254	none		
LIVESTOCK	-	-	1,711	1,711	none		
Limestone County	***Section 2.2***		***Section 2.3***		***Section 4.2.23***		
COOLIDGE	690	636	98	78	none		
GROESBECK	3,740	5,296	721	908	(756)	I.S.	Groesbeck off-channel reservoir (See Section 5B.23.2)
KOSSE	489	414	106	80	none		
MEXIA	7,410	8,462	1,054	1,033	none		
THORNTON	606	629	69	60	none		
COUNTY-OTHER	9,606	11,405	1,434	1,460	none		
Bistone WSD	part of County-Other		part of County-Other				Further development of Carrizo-Wilcox Aquifer (See Section 5B.23.6.1)
MANUFACTURING	-	-	453	779	(777)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.23.7)
STEAM-ELECTRIC	-	-	18,000	20,000	none		
MINING	-	-	941	976	none		
IRRIGATION	-	-	0	0	none		
LIVESTOCK	-	-	1,427	1,427	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
McLennan County	*Section 2.2*		*Section 2.3*		*Section 4.2.24*		
BELLMEAD	10,047	11,592	1,317	1,311	none		
BEVERLY HILLS	2,387	3,031	553	628	none		
BRUCEVILLE-EDDY	2,078	4,080	291	530	none		
CRAWFORD	667	532	128	90	none		
GHOLSON	703	618	100	76	none		
HEWITT	15,060	27,977	2,227	3,573	none		
LACY-LAKEVIEW	4,330	5,770	495	549	none		
LORENA	1,889	3,787	267	437	none		
MART	2,323	2,917	487	549	none		
MCGREGOR	5,228	6,106	1,089	1,129	(313)	#3	Infrastructure capacity expansion (See Section 5B.24.10)
MOODY	1,396	2,048	188	232	none		
NORTHCREST	1,802	1,904	208	183	none		
RIESEL	724	657	98	77	none		
ROBINSON	8,183	10,149	1,146	1,216	(551)	#3	Infrastructure capacity expansion (See Section 5B.24.13)
VALLEY MILLS (P)	12	11	2	1	none		
WACO	119,455	161,819	27,698	33,533	none		
WEST	2,611	2,565	524	454	(399)	I.S.	Purchase water from City of Waco (See Section 5B.24.17)
WOODWAY	11,313	15,397	2,737	3,346	none		
COUNTY-OTHER	39,161	47,289	5,832	5,957	(4,029)	I.S.	Purchase water from City of Waco (See Section 5B.24.19)
MANUFACTURING	-	-	3,106	4,419	(4,384)	I.S.	Purchase water from City of Waco (See Section 5B.24.20)
STEAM-ELECTRIC	-	-	15,000	25,000	none		
MINING	-	-	750	1,071	(1,071)	I.S.	Purchase water from City of Waco (See Section 5B.24.22)
IRRIGATION	-	-	3,067	3,059	none		
LIVESTOCK	-	-	1,873	1,873	none		
Milam County	*Section 2.2*		*Section 2.3*		*Section 4.2.25*		
CAMERON	5,963	6,416	1,363	1,308	none		
ROCKDALE	6,382	7,992	1,730	1,943	none		
THORNDALE	1,291	1,477	143	136	none		
COUNTY-OTHER	11,777	13,560	1,796	1,851	none		
MANUFACTURING	-	-	6,820	8,250	none		
STEAM-ELECTRIC	-	-	8,680	12,500	(3,498)	#1	Renew existing contract with BRA from Lake Granger (See Section 5B.25.6)
MINING	-	-	30,008	20,009	none		
IRRIGATION	-	-	1,400	1,366	none		
LIVESTOCK	-	-	1,627	1,627	none		

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* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Nolan County	Section 2.2		Section 2.3		Section 4.2.26		
ROSCOE	1,523	1,699	280	272	none		
SWEETWATER	12,219	12,772	3,914	3,705	none		City uses lower supply estimates with resulting shortages; Plan inludes reuse; diversion to Lake Sweetwater; development of Champion Well Fiels (See Section 5B.26.2)
COUNTY-OTHER	3,413	3,563	715	667	(155)	#1	Renew existing contracts with City of Sweetwater (See Section 5B.26.3)
MANUFACTURING	-	-	558	747	(697)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.26.4)
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	482	356	none		
IRRIGATION	-	-	1,835	1,694	none		
LIVESTOCK	-	-	905	905	none		
Palo Pinto County	Section 2.2		Section 2.3		Section 4.2.27		
GRAFORD	560	475	74	54	none		
MINERAL WELLS (P)	15,334	17,545	2,868	2,869	none		
PALO PINTO	449	467	89	82	(82)	#1	Renew existing contract with Mineral Wells (See Section 5B.27.3)
STRAWN	624	541	99	75	none		
COUNTY-OTHER	9,694	12,858	1,218	1,388	none		
MANUFACTURING	-	-	65	93	(86)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.27.6)
STEAM-ELECTRIC	-	-	2,500	3,000	none		
MINING	-	-	2	3	none		
IRRIGATION	-	-	473	455	none		
LIVESTOCK	-	-	1,046	1,046	none		
Robertson County	Section 2.2		Section 2.3		Section 4.2.28		
BREMOND	1,380	1,855	161	181	none		
CALVERT	1,655	2,252	441	540	none		
FRANKLIN	1,594	2,210	245	290	none		
HEARNE	5,850	7,963	1,278	1,543	(67)	#2	Further development of Carrizo-Wilcox Aquifer (See Section 5B.28.4)
COUNTY-OTHER	6,152	6,732	811	692	none		
MANUFACTURING	-	-	42	72	none		
STEAM-ELECTRIC	-	-	15,000	30,000	none		
MINING	-	-	45	45	none		
IRRIGATION	-	-	20,745	19,479	none		
LIVESTOCK	-	-	1,704	1,704	none		

(P) Indicates City is in multiple counties; projections shown are for this county only.
* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Shackelford County	*Section 2.2*		*Section 2.3*		*Section 4.2.29*		
ALBANY	2,043	2,850	553	447	none		
COUNTY-OTHER	1,544	1,446	198	152	none		
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	433	383	(333)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.29.5)
IRRIGATION	-	-	230	210	(179)	I.S.	Additional conservation through system conversion; brush control; weather modification; Unmet demands of 133 acft (Section See Section 5B.29.6)
LIVESTOCK	-	-	760	760	none		
Somervell County	*Section 2.2*		*Section 2.3*		*Section 4.2.30*		
GLEN ROSE	2,335	3,493	473	685	(300)	I.S.	Off-channel storage reservoir (See Section 5B.30.1)
COUNTY-OTHER	4,136	7,889	556	1,122	(734)	I.S.	Off-channel storage reservoir (See Section 5B.30.2)
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	18,000	23,200	none		
MINING	-	-	326	273	none		
IRRIGATION	-	-	348	343	none		
LIVESTOCK	-	-	120	120	none		
Stephens County	*Section 2.2*		*Section 2.3*		*Section 4.2.31*		
BRECKENRIDGE	5,875	6,524	1,448	1,432	none		
COUNTY-OTHER	3,365	3,917	535	411	none		
MANUFACTURING	-	-	7	8	(1)	I.S.	Purchase/lease water through voluntary redistribution from municipal users (See Section 5B.31.3)
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	448	131	none		
IRRIGATION	-	-	494	475	(341)	I.S.	Additional conservation through system conversion and pecan-micro irrigation upgrade; brush control; weather modification; Unmet demands of 193 acft (Section See Section 5B.31.6)
LIVESTOCK	-	-	773	773	none		
Stonewall County	*Section 2.2*		*Section 2.3*		*Section 4.2.32*		
ASPERMONT	1,199	1,152	246	208	none		Renew existing contract with NCTMWA; Brine Utilization Management Complex chloride control (See Section 5B.32.1)
COUNTY-OTHER	818	766	125	100	none		
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	219	53	none		
IRRIGATION	-	-	522	477	none		
LIVESTOCK	-	-	590	590	none		

(P) Indicates City is in multiple counties; projections shown are for this county only.
* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Taylor County	***Section 2.2***		***Section 2.3***		***Section 4.2.33***		
ABILENE (P)	119,048	156,116	27,737	35,674	(2,610)	#3	Reuse; Construct O.H. Ivie pipeline; Coordinated use of Hubbard Creek/Fort Phantom Hill; Oryx/Kerr-McGee pipeline; Develop Seymour Aquifer (See Section 5B.33.1)
MERKEL	3,416	4,452	597	678	(294)	I.S.	Purchase water from City of Abilene; Reuse (See Section 5B.33.2)
POTOSI (CDP)	1,473	962	201	111	none		
TUSCOLA	602	549	98	77	none		
TYE	1,152	1,199	143	126	none		
COUNTY-OTHER	12,901	15,961	1,906	1,669	none		
MANUFACTURING	-	-	1,775	2,201	(1,953)	I.S.	Purchase water from City of Abilene (See Section 5B.33.7)
STEAM-ELECTRIC	-	-	300	300	none		
MINING	-	-	245	178	none		
IRRIGATION	-	-	475	442	(68)	I.S.	Additional conservation through system conversion; brush control; weather modification (Section See Section 5B.33.10)
LIVESTOCK	-	-	3,645	3,645	none		
Throckmorton County	***Section 2.2***		***Section 2.3***		***Section 4.2.34***		
THROCKMORTON	1,028	961	193	158	(158)	I.S.	New reservoir; Purchase water from City of Graham (See Section 5B.34.1)
COUNTY-OTHER	829	776	98	76	(50)	I.S.	New reservoir; Purchase/lease water through voluntary redistribution from Lake Graham (See Section 5B.34.2)
MANUFACTURING	-	-	0	0	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	34	25	none		
IRRIGATION	-	-	0	0	none		
LIVESTOCK	-	-	989	989	none		
Washington County	***Section 2.2***		***Section 2.3***		***Section 4.2.35***		
BRENHAM	13,603	16,195	2,438	2,540	none		
COUNTY-OTHER	16,523	20,366	2,021	2,142	none		
MANUFACTURING	-	-	495	569	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	131	119	none		
IRRIGATION	-	-	205	205	none		
LIVESTOCK	-	-	1,504	1,504	none		

(P) Indicates City is in multiple counties; projections shown are for this county only.
* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Williamson County	*Section 2.2*		*Section 2.3*		*Section 4.2.36*		
BARTLETT (P)	840	973	197	205	none		
BRUSHY CREEK MUD (CDP)	12,589	23,800	2,538	4,345	(4,020)	#1,#3	Divert and treat Lake Stillhouse Hollow water delivered to Lake Georgetown (See Section 5B.36.2)
CEDAR PARK	17,439	46,915	3,516	8,916	none		
FLORENCE	1,060	2,097	195	340	(136)	I.S.	Purchase/lease water through voluntary redistribution from Lake Stillhouse-Hollow (See Section 5B.36.4)
GEORGETOWN	33,357	100,432	7,052	17,416	(8,151)	#3	Expand intake, pumping, and conveyance facilities at Lake Georgetown (See Section 5B.36.5)
GRANGER	1,574	3,091	245	374	(129)	I.S.	Carrizo-Wilcox Aquifer regional water supply (See Section 5B.36.6)
HUTTO	1,065	3,216	131	396	(265)	I.S.	Carrizo-Wilcox Aquifer regional water supply (See Section 5B.36.7)
LEANDER	9,381	26,478	1,891	4,832	none		
ROUND ROCK (P)	58,742	165,487	13,339	30,839	(12,157)	#3	Expand Intake at Lake Georgetown; Carrizo-Wilcox Aquifer regional water supply; Purchase from BRA/LCRA; Reuse (See Section 5B.36.9)
TAYLOR	16,025	35,597	3,016	5,861	none	#3	Infrastructure capacity expansion; Carrizo-Wilcox Aquifer regional water supply (See Section 5B.36.10)
THRALL	691	1,224	83	123	(40)	I.S.	Purchase water from City of Taylor (See Section 5B.36.11)
COUNTY-OTHER	55,009	179,271	7,024	18,319	(11,750)	#3	Carrizo-Wilcox Aquifer regional water supply; Purchase from BRA/LCRA; Reuse (See Section 5B.36.12)
MANUFACTURING	-	-	368	405	none		
STEAM-ELECTRIC	-	-	0	0	none		
MINING	-	-	1,872	1,948	(1,543)	I.S.	Continue groundwater use; purchase water from nearby entities (See Section 5B.36.15)
IRRIGATION	-	-	160	160	none		
LIVESTOCK	-	-	1,313	1,313	none		
Young County	*Section 2.2*		*Section 2.3*		*Section 4.2.37*		
GRAHAM	8,949	8,794	2,085	1,822	none		
NEWCASTLE	529	589	107	106	none		
COUNTY-OTHER	4,955	6,066	636	567	none		
MANUFACTURING	-	-	158	223	(223)	I.S.	Purchase water from nearby entity (See Section 5B.37.4)
STEAM-ELECTRIC	-	-	3,000	3,500	(3,500)	I.S.	(See Section 5B.37.5)
MINING	-	-	255	134	none		
IRRIGATION	-	-	456	408	(265)	I.S.	Conversion to dryland farming (See Section 5B.37.7)
LIVESTOCK	-	-	879	879	none		

(P) Indicates City is in multiple counties; projections shown are for this county only.
* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

Table ES-4. Water Plan Summary

County/ Water User Group	Population 2000	Population 2030	Demand 2000	Demand 2030	2030 Shortage	Type of Shortage*	Recommended Actions to Meet Shortage
Major Water Provider			***Section 4.3***		***Section 4.3***		
Brazos River Authority	-	-	764,731	858,731	(90,259)	I.S.	Development of Carrizo-Wilcox supplies;Millican Reservoir - Bundic site;Little River Reservoir; Voluntary redistribution; System operation; Purchase of water from LCRA for BRA/LCRA alliance; South Bend Reservoir; Lake Whitney reallocation; Chloride Control Project (See Section 5B.38.1)
West Central Texas MWD	-	-	23,792	23,792	none		Development of Seymour Aquifer; Breckenridge Reservoir (See Section 5B.38.2)
City of Abilene	-	-	49,458	57,463	none		Reuse; Construct O.H. Ivie pipeline; Coordinated use of Hubbard Creek/Fort Phantom Hill; Oryx/Kerr-McGee pipeline; Develop Seymour Aquifer (See Section 5B.33.1)
City of Waco	-	-	38,791	44,770	none		(See Section 5B.22.16)
City of Round Rock	-	-	32,470	41,897	(6,695)	I.S.	Expand Intake at Lake Georgetown; Carrizo-Wilcox Aquifer regional water supply; Purchase from BRA/LCRA; Reuse (See Section 5B.36.9)
Central Texas WSC	-	-	8,200	8,200	none		Facility extensions (See Section 5B.38.6)
Bell County WCID #1	-	-	49,509	49,509	none		(See Section 5B.38.7)
Lower Colorado River Auth.	-	-	48,350	48,350	none		(See Section 5B.38.8)

(P) Indicates City is in multiple counties; projections shown are for this county only.
* Types of Shortages: I.S -Insufficient Supply; #1- Contract expiration; #2 - Well Capacity Limitation; #3 - Infrastructure Limitation

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Section 1
Description of the Region

1.1 Senate Bill 1

In June 1997, Governor George W. Bush signed into law Senate Bill 1 (SB1), a comprehensive bill for water planning and management enacted by the 75th Texas Legislature. This law stemmed from increased awareness of Texas' vulnerability to drought and of the limitations of existing water supplies to meet the needs of a growing population. The population of Texas is expected to increase from an estimated 20 million in 2000 to more than 36 million by the year 2050, and some areas of the State are already facing near-term water shortages. The purpose of SB1 is to ensure that the water needs of all Texans are met in the 21st century.

SB1 calls for a "bottom up" water planning process wherein Regional Water Planning Groups (RWPGs) are to be formed by members representing 11 different interests, including the environment, industry, water authorities, and the public. Each RWPG will prepare a water plan for its geographic area to address how to conserve water supplies, how to meet future demand, and how to respond to droughts. The Texas Water Development Board (TWDB) has established 16 regional water planning areas, each with its own RWPG.

In accordance with SB1 (as amended), all of the regional water plans must be completed and adopted by January 5, 2001. The TWDB must approve them and incorporate the 16 plans into one statewide plan by January 5, 2002. After that, the regional water plans will be updated every 5 years.

1.2 Brazos G Regional Water Planning Area

The Brazos G Regional Water Planning Area (BGRWPA), shown in Figure 1-1, comprises all or portions of 37 central Texas counties. The Brazos G Region is about 31,600 square miles in area, or 12 percent of the State's total area. About 90 percent of the region lies in the Brazos River Basin. Figure 1-2 shows the major physical features of the BGRWPA, such as major cities, reservoirs, and highways. This figure also shows that parts of several counties are in the basins of the Red, Trinity, Colorado, and San Jacinto Rivers. Cities in

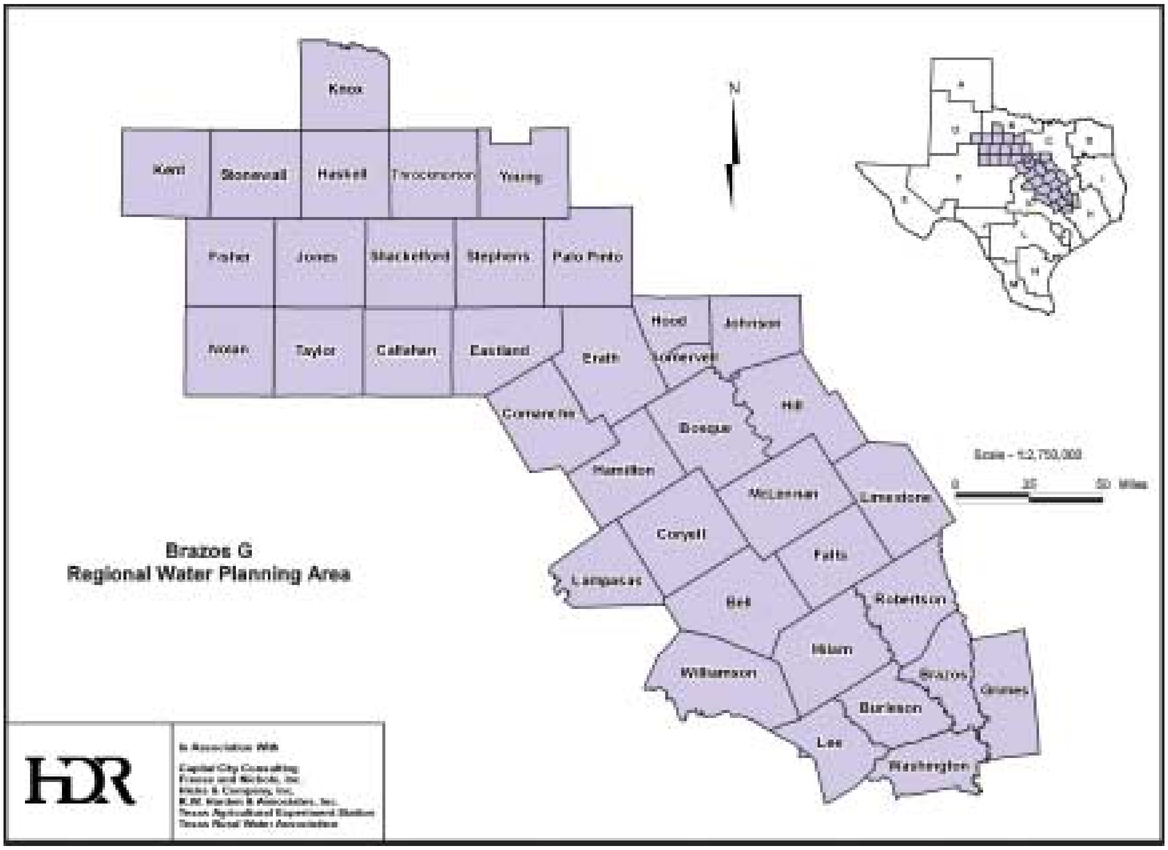

Figure 1-1. Location Map

the region with populations estimated in 1998 to be more than 50,000 are Abilene, Bryan, College Station, Killeen, Round Rock, Temple, and Waco.[1]

The region's geography varies from the rugged, uneven terrain and sandy soils of Kent and Knox Counties in the northwest to the hilly, forested areas and rich soils in Grimes and Washington Counties in the southeast. In the central part of the region are the Blackland Prairies in Hill and McLennan Counties.[2]

The Brazos G RWPG consists of 18 individuals, listed in Table 1-1, who represent the following 11 interests: the public, counties, municipalities, industries, agriculture, the environment, small businesses, electric-generating utilities, river authorities, water districts, and

[1] Texas State Data Center, "Estimated 1998 Populations for Texas Cities and Counties", [Online] Available URL: http://www.txsdc.tamu.edu/txmsa97.html, May 1998.
[2] The Dallas Morning News, *1998-1999 Texas Almanac*, 1997.

Table 1-1.
Brazos G RWPG Members[1]

Interest Group	*Name*	*Entity*
Agricultural	Steve Sanford Chaunce Thompson	Farmer/Rancher Cattlemen
Counties	John Garth Tony Jones Judge David Perdue	County Government Brazos County Commissioners Court Knox County
Electric Generating Utilities	Ken Smith	TXU Electric
Environmental	Stephen L. Stark	Sportsmans Conservationists of Texas
Industry	Mark Bryson	Alcoa Aluminum
Municipalities	Mayor Truman O. Blum John Hatchel Mike Morrison James Nuse	City of Clifton City of Waco City of Abilene City of Round Rock
Public	Scott Mack, DDS	Dentist
River Authorities	Gary Gwyn	Brazos River Authority
Small Business	Horace R. Grace	AMG Enterprises, Inc.
Water Districts	A.V. Jones, Jr. _______________	West Central Texas Municipal Water District Seat Currently Empty
Water Utilities	Kent Watson	Wickson Creek Special Utility District

[1] As of July 2000.

water utilities. The Brazos G RWPG has retained the services of engineering firms and other specialists to prepare the regional plan, and it has designated the Brazos River Authority (BRA) as its administrative contracting agency.

1.2.1 Population

1.2.1.1 Regional Trends

Figure 1-3 illustrates population growth in the entire BGRWPA for 1900 to 1998 and projected growth for 2010 to 2050. Table A-1 in Appendix A gives historical population data for each county in the BGRWPA, as well as regional and State population totals, for 1990 to 1998.

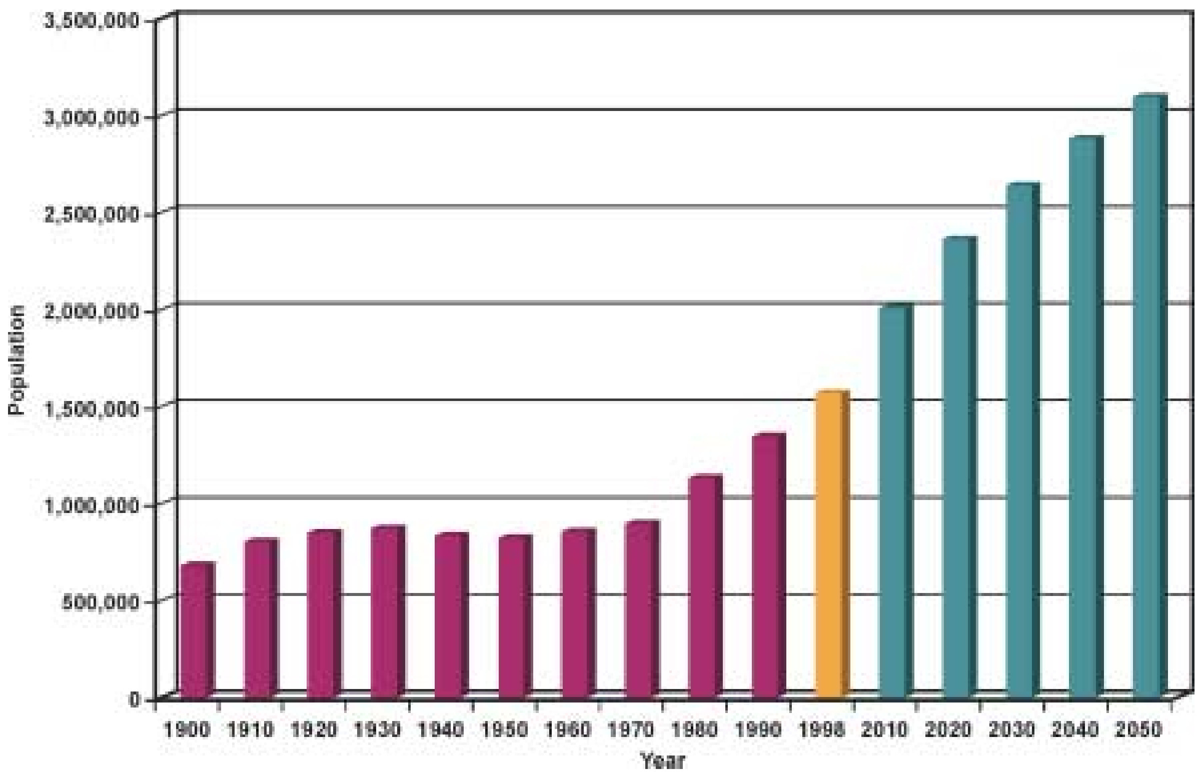

Figure 1-3. Historical and Projected BGRWPA Population

From 1900 to 1970, population in the Brazos G Region grew slowly at an average rate of 0.5 percent per year from 680,093 people to 895,682. During the same period, the total population of Texas grew at an average rate of 3.8 percent annually, from 3,048,710 to 11,196,730. Beginning in the 1970s, however, both the State's and the region's population began to increase at a faster rate. Growth in the region was about 2.5 percent annually, which was close to the State's total growth rate. Population in the BGRWPA is expected to increase by an average of 1.2 percent annually, reaching 3.1 million by 2050. This is roughly double the estimated population in 1998.

Population trends may be further understood by dividing the BGRWPA into three subregions: the northwestern Rolling Plains, the central IH-35 Corridor, and the southeastern Lower Basin. Table A-2 in Appendix A provides historical population data for all counties in each subregion from 1990 to 1998.

Figure 1-4 shows historical population growth in the three sub-regions from 1900 to 1998 and projected growth from 2010 to 2050. Projected growth is greatest in the IH-35 Corridor. Figure 1-5 shows population distribution by county in 1998, and Figure 1-6 shows the distribution for the year 2050. Table 1-2 shows 1998 populations and projected populations for 2010 and 2050 for the major cities in each sub-region. Major cities are defined as those having at least 10,000 people in 1998. This table also shows the percent change in populations from 2010 to 2050 in each city. About 53 percent of the population in the BGRWPA was in major cities in 1998, and this proportion is expected to increase to about 56 percent by 2050.

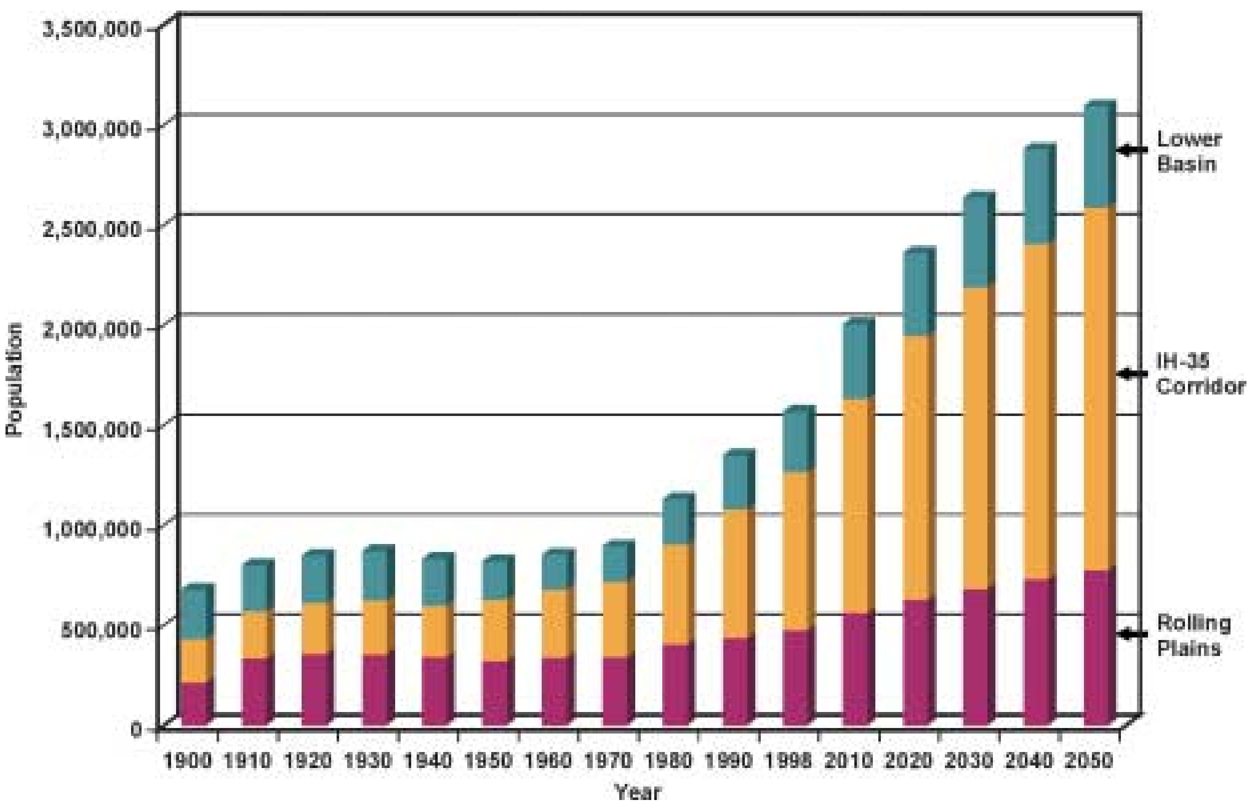

Figure 1-4. Historical and Projected Population by Sub-Region

1.2.1.2 Rolling Plains

The counties in the Rolling Plains subregion are Knox, Kent, Stonewall, Haskell, Throckmorton, Young, Fisher, Jones, Shackelford, Stephens, Palo Pinto, Nolan, Taylor, Callahan, Eastland, Erath, Hood, Somervell, Comanche, Hamilton, Bosque, Coryell, and

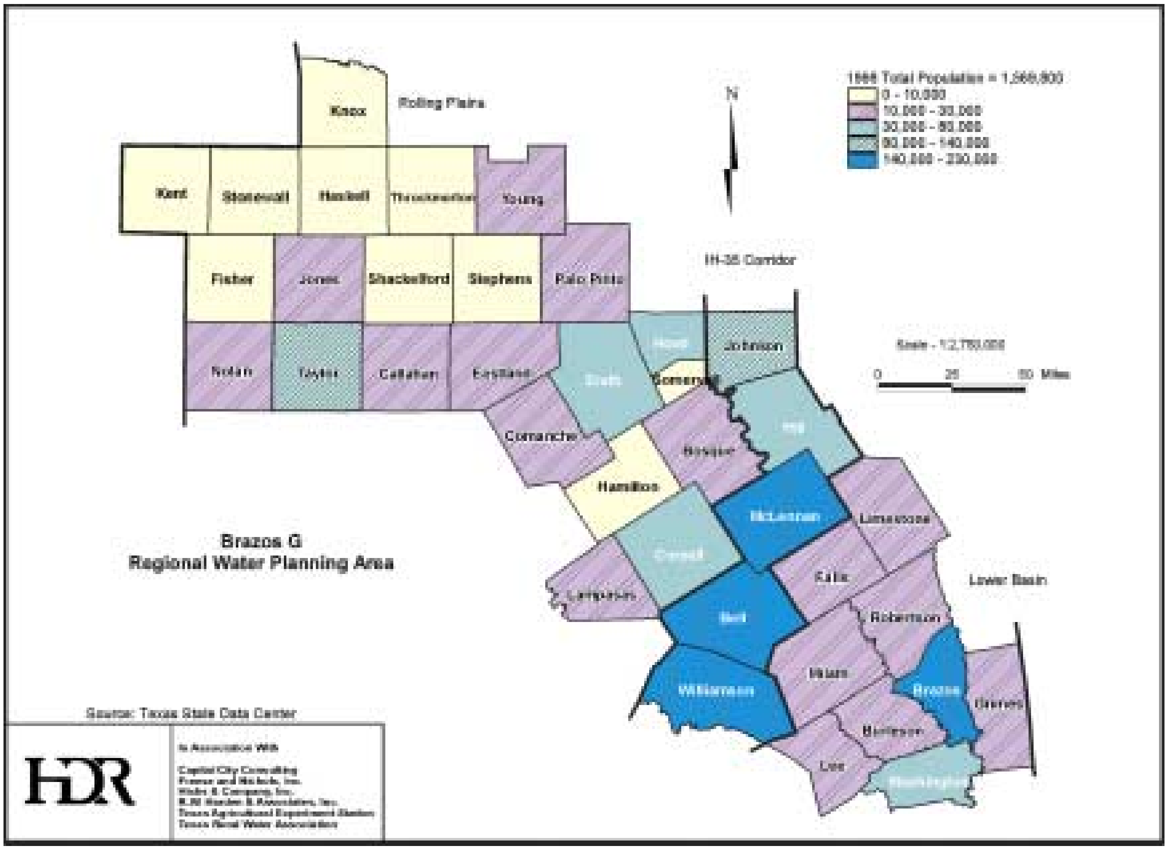

Figure 1-5. 1998 Population Distribution by County

Lampasas. These counties, with about 31 percent of the BGRWPA's population in 1998, have grown moderately since 1970 at an average rate of 1.4 percent per year. Major cities in this subregion include Abilene, Copperas Cove, Gatesville, Mineral Wells, Stephenville, and Sweetwater.

1.2.1.3 IH-35 Corridor

The counties in the IH-35 Corridor are Johnson, Hill, McLennan, Bell, and Williamson. Population growth in these counties has been rapid since 1970, averaging 3.9 percent annually. In this subregion, cities with a population estimated in 1998 to be at least 10,000 include Belton, Burleson, Cleburne, Fort Hood, Georgetown, Harker Heights, Hewitt, Killeen, Round Rock, Taylor, Temple, and Waco. Population in the IH-35 Corridor was about 50 percent of the region's total in 1998, and it is expected to keep growing at a fast rate.

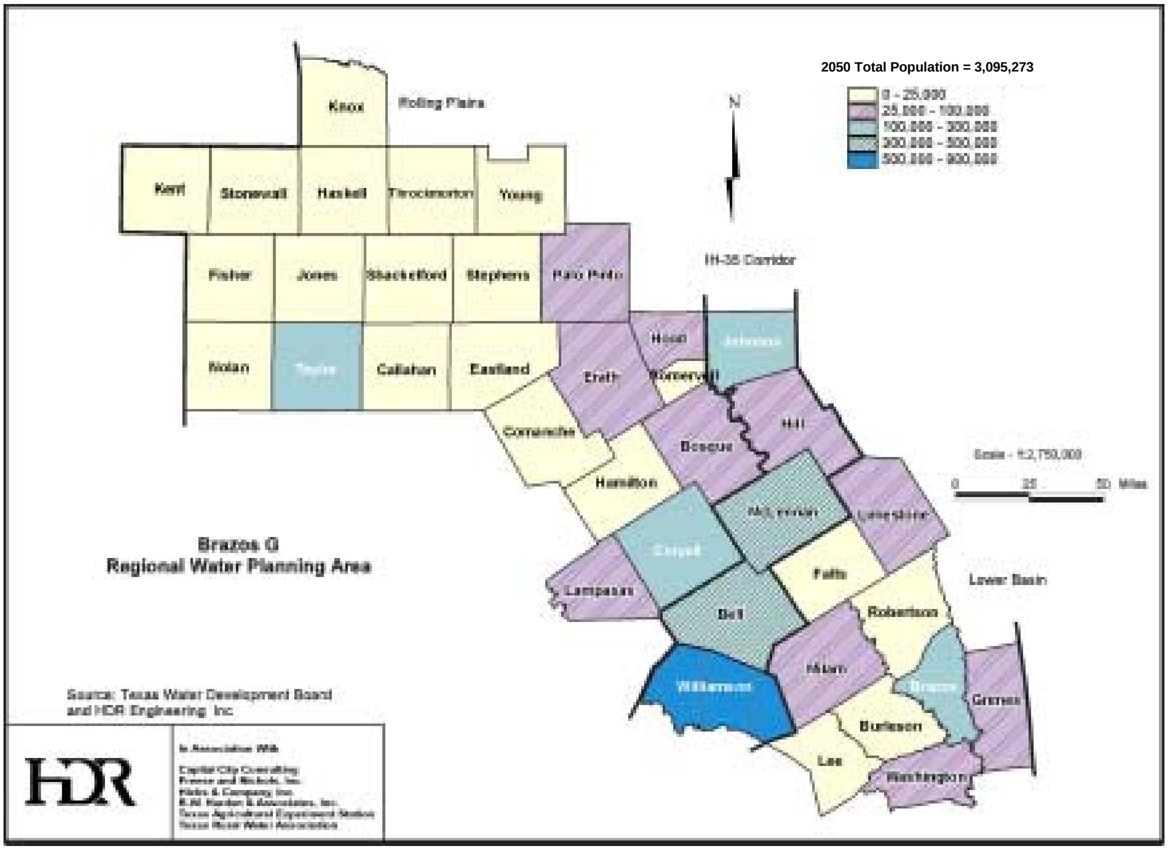

Figure 1-6. 2050 Population Distribution by County

1.2.1.4 Lower Basin

Counties in the Lower Basin are Limestone, Falls, Milam, Robertson, Lee, Burleson, Brazos, Washington, and Grimes. This subregion also has seen a relatively high growth rate averaging 2.5 percent annually since 1970. Major cities include Brenham, Bryan, and College Station. The Lower Basin held 19 percent of the population of the BGRWPA in 1998.

1.2.2 Economic Activities

The BGRWPA includes all or part of the following metropolitan statistical areas as defined by the Texas State Data Center: Abilene, Waco, Temple-Killeen, Austin-San Marcos, and Bryan-College Station. The economy of the region can be divided into the following general sectors: agriculture, agribusiness, mineral production, wholesale and retail trade, and varied

Table 1-2.
Population of Major Cities in the BGRWPA
(Greater than 10,000 People in 1998)

City	County	Population Data[1] 1998	2010	2050	% Change (2010 to 2050)
Rolling Plains					
Abilene	Jones, Taylor	117,111	132,480	178,617	34.8
Copperas Cove	Coryell	30,708	45,328	99,271	119.0
Gatesville	Coryell	12,340	22,423	49,287	119.8
Mineral Wells	Palo Pinto	15,367	16,012	18,712	16.9
Stephenville	Erath	15,589	18,638	26,143	40.3
Sweetwater	Nolan	11,733	12,644	12,297	-2.7
IH-35 Corridor					
Belton	Bell	15,541	20,088	29,593	47.3
Burleson	Johnson	20,500	24,039	43,773	82.1
Cedar Park	Williamson	13,659	30,978	56,026	80.9
Cleburne	Johnson	24,277	30,788	59,188	92.2
Fort Hood	Bell, Coryell	38,259	35,580	35,580	0.0
Georgetown	Williamson	26,576	54,419	163,777	201.0
Harker Heights	Bell	17,243	22,404	33,294	48.6
Hewitt	McLennan	10,718	20,713	28,523	37.7
Killeen	Bell	84,488	105,924	154,249	45.6
Round Rock	Williamson	53,427	92,430	197,313	113.5
Taylor	Williamson	14,722	22,028	48,996	122.4
Temple	Bell	51,476	69,800	102,060	46.2
Waco	McLennan	110,024	135,407	192,621	42.3
Lower Basin					
Brenham	Washington	13,796	14,863	15,337	3.2
Bryan	Brazos	62,685	76,382	119,709	56.7
College Station	Brazos	64,119	96,974	138,771	43.1
Total, Major Cities	—	824,358	1,100,342	1,803,137	63.9
% of Region Total	—	52.6	54.8	58.3	
Total, Rural Areas	—	743,437	905,888	1,292,136	42.6
% of Region Total	—	47.4	45.2	41.7	
Region Total	—	1,567,795	2,006,230	3,095,273	54.3

[1] 1998 population data obtained from Texas State Data Center. 2010 and 2050 projections are TWDB or approved revision.

manufacturing. Table 1-3 lists 1995 payrolls and employment in the BGRWPA by sub-region and economic sector.[3] As of this writing, 1995 was the most recent year for which such data were available. Payroll and employment in the Brazos G Region were concentrated along the IH-35 Corridor, which in 1995 had a total payroll of about $4.3 billion and employment of over 211,000 people. Primary economic activities accounting for about 69 percent of the region's total payroll in 1995 were manufacturing, retail trade, and services.

Table 1-3.
1995 Economic Data[1]
(x$1,000)

Economic Sector	*Rolling Plains*	*IH-35 Corridor*	*Lower Basin*	*Region Total*
Agricultural, Forestry, Fishing	$11,062	$18,546	$8,258	$37,866
Mining	$93,360	$19,259	$49,813	$162,432
Construction	$116,711	$295,443	$82,851	$495,005
Manufacturing	$287,420	$1,035,039	$307,656	$1,630,115
Transportation, Public Utilities	$148,619	$245,949	$85,847	$480,415
Wholesale Trade	$118,579	$295,645	$92,806	$507,030
Retail Trade	$341,208	$634,257	$220,879	$1,196,344
Finance, Insurance, Real Estate	$114,908	$361,882	$93,548	$570,338
Services	$648,024	$1,387,420	$411,138	$2,446,582
Unclassified	$1,017	$2,987	$1,100	$5,104
Not Categorized	$88,868	$0	$5,927	$94,795
Total Payroll	$1,969,776	$4,296,427	$1,359,823	$7,626,026
Total Employed	107,150	211,097	70,517	388,764

1 Data from U.S. Census Bureau.

1.2.3 Climate

Temperatures in the Brazos G Region range from an average low of 35°F in January to an average high of 95°F in July. Average annual precipitation ranges from 20 to 24 inches in Kent County in the northwest corner of the region to 40 to 44 inches in Washington and Grimes Counties in the southeast. Figure 1-7 depicts average annual precipitation for the entire region.

3 U.S. Census Bureau, "1995 Economic Data," Online: available URL: http://www.census.gov/datamap/May 1998.

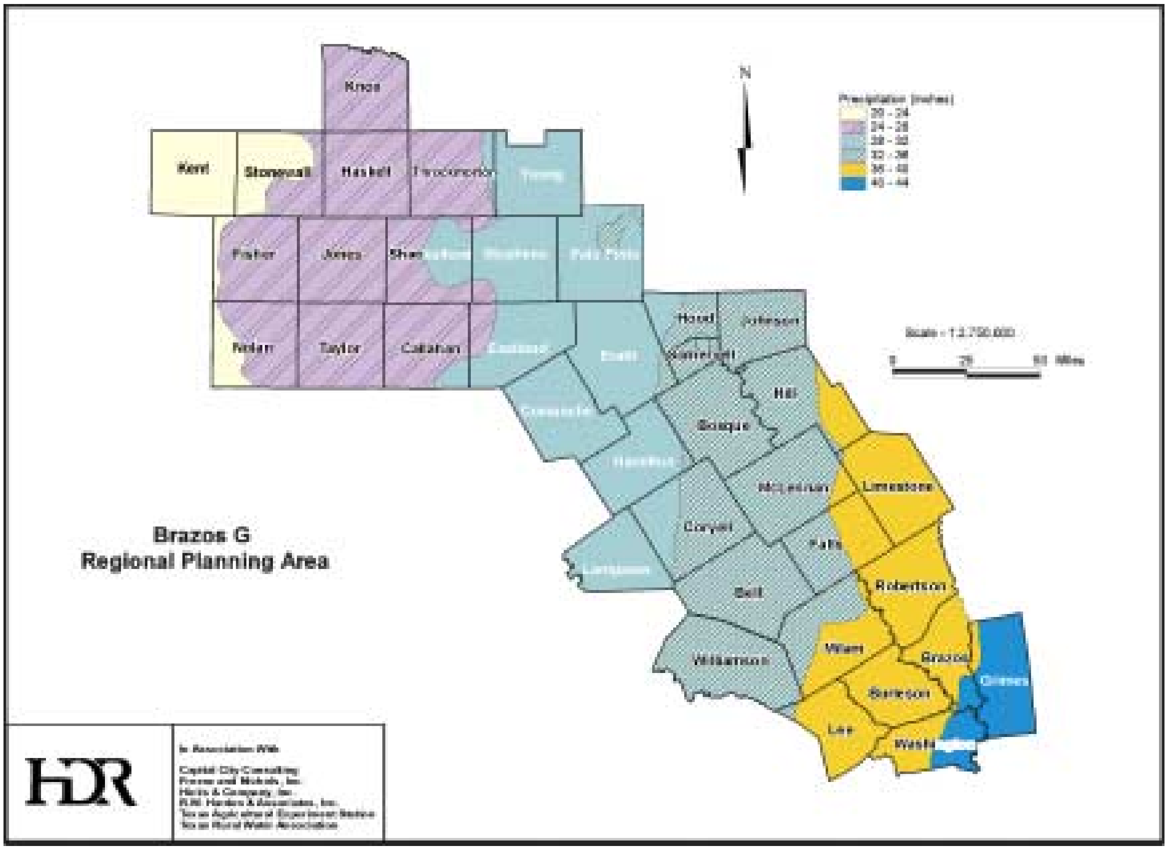

Figure 1-7. Average Annual Precipitation (1961 to 1990)

1.3 Sources of Water

Table A-3 in Appendix A provides historical data on use of groundwater and surface water by the BGRWPA from 1980 to 1997. These data suggest that the planning area has depended slightly more on surface water than on groundwater during the 1980s and 1990s. Figure 1-8 shows the proportion of surface water use to groundwater use in 1980, 1990, and 1996. While the proportions were equal in 1980, surface water use was slightly greater (by 4 percent) in 1990 and 1996.

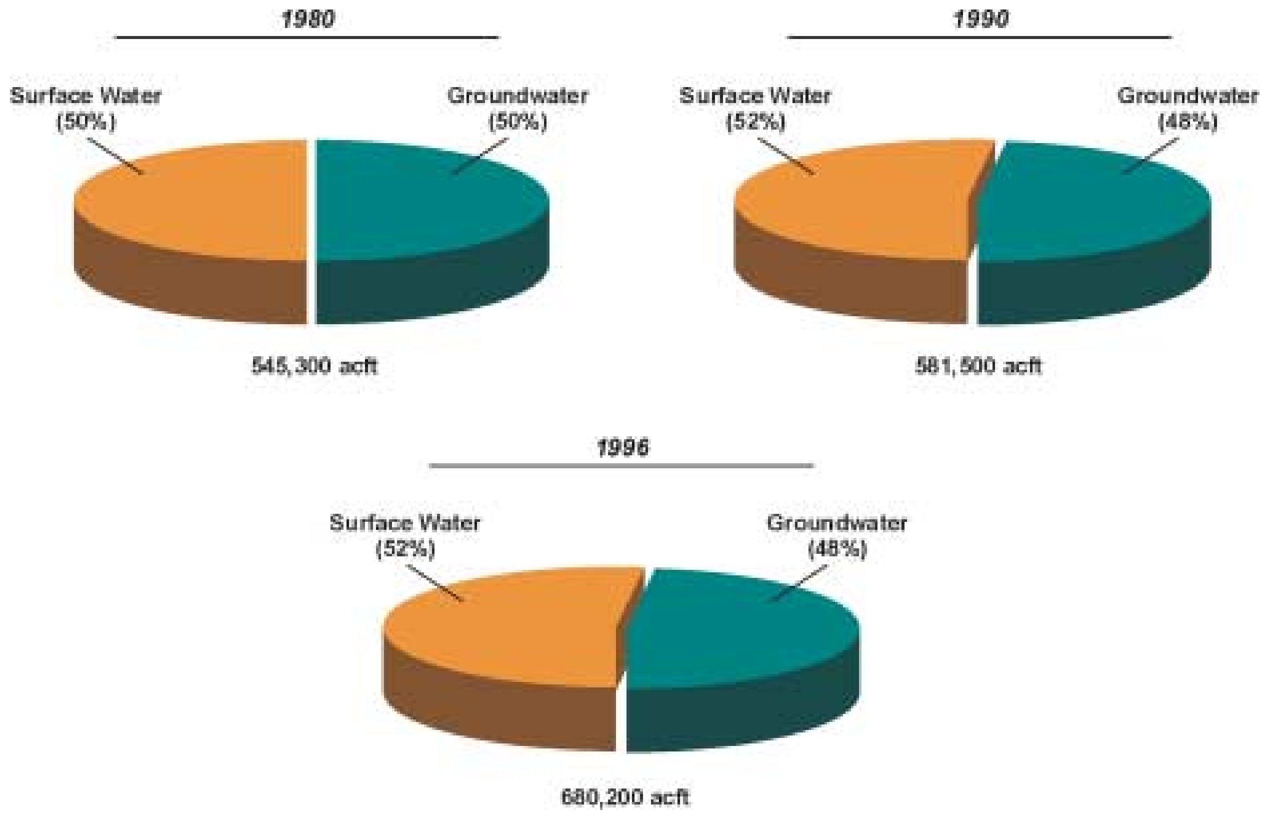

Figure 1-8. BGRWPA Historical Water Use by Source

1.3.1 Groundwater

1.3.1.1 Aquifers[4,5,6]

Portions of 15 aquifers extend into the Brazos G Region. Of these, there are six major aquifers (Figure 1-9) and nine minor ones (Figure 1-10). Major aquifers were defined generally in the State's 1997 *Water for Texas* plan as those aquifers that supply large amounts of water to large areas of the State. Minor aquifers were defined as those that supply large amounts of water to small areas of the State or that provide small supplies to wide areas. Figure 1-11 shows water use for each aquifer in the BGRWPA in 1980, 1990, and 1996. In 1996, about 80 percent of the groundwater used came from three aquifers: Seymour, Trinity, and Carrizo-Wilcox.

[4] Texas Water Commission, *Groundwater Quality in Texas - An Overview of Natural and Man-Affected Conditions*, TWC Report No. 89-01, 1989.
[5] Texas Water Development Board (TWDB), *Water for Texas*, 1997.
[6] TWDB, *Estimated Groundwater Pumpage by County and Aquifer*, 1998.

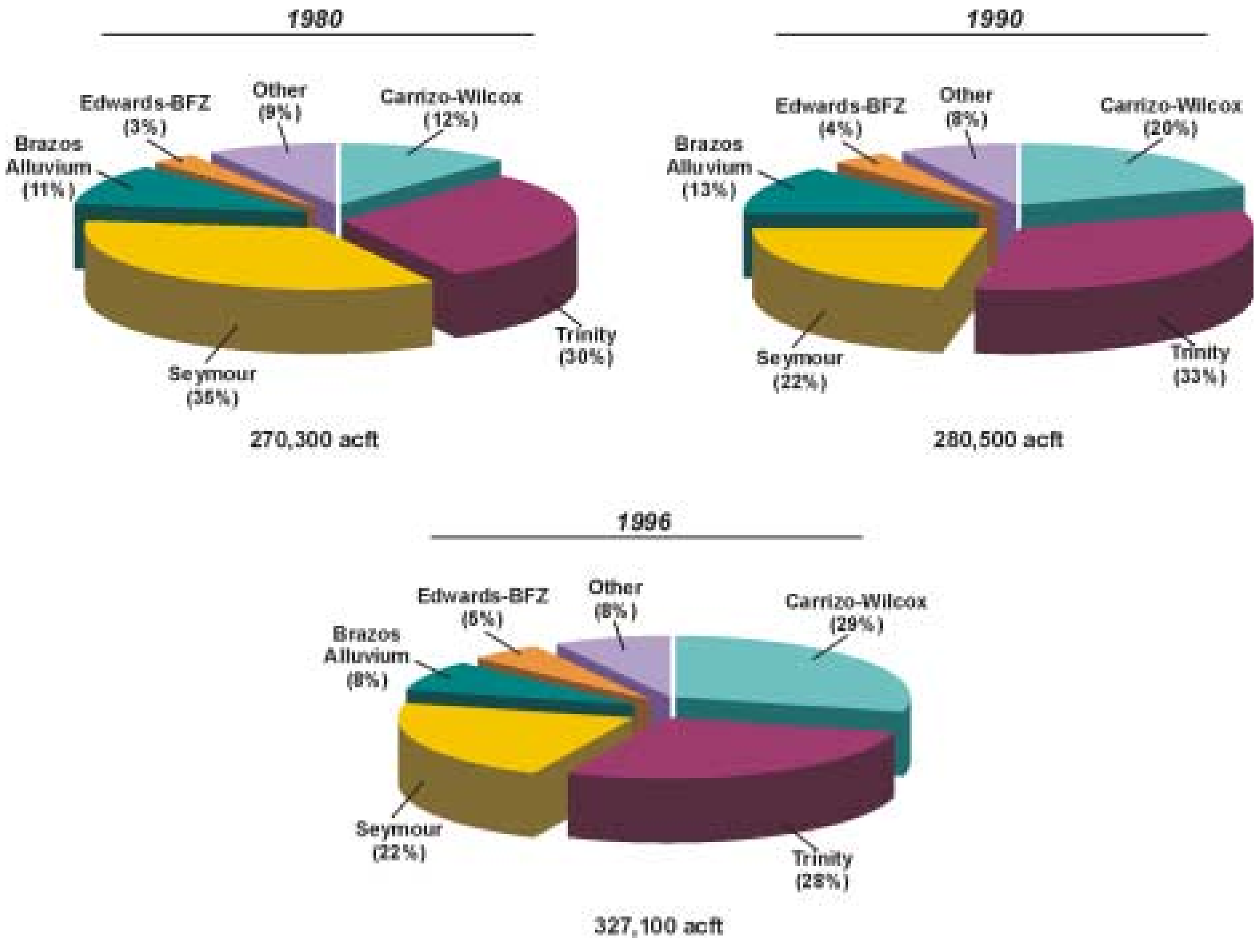

Figure 1-11. Brazos G Region Historical Water Use by Aquifer

Table 1-4 depicts use in 1996 and projected availability in 2050 of groundwater in each aquifer in the BGRWPA. Data on historical water use per aquifer in the 1980s and 1990s is in Table A-4 in Appendix A.

Fewer than half of the aquifers in the BGRWPA have potential for further development. Seven of them extend only slightly into the planning area. The several aquifers that do offer potential for further development are all in the southeastern part of the region.

In the western part of the region, the Seymour Aquifer is the most significant in terms of usage and yield. The Seymour Aquifer, which has an uneven distribution, is highly developed, and most of its water is used for irrigation. The aquifer is prone to depletion if subjected to a combination of prolonged drought and heavy use, but groundwater supply in the aquifer has

**Table 1-4.
Brazos G Region Aquifers**

Aquifer	1996 Use (acft)	2050 Availability (acft/yr)	Remarks
Western Area			
Seymour	70,790	69,893	Essentially developed
Dockum	2,860	3,484	Limited extent within region
Blaine	ND[1]	1,333	Limited extent within region
Edwards-Trinity (Plateau)	570	800	Limited extent within region
Subtotal:	74,220	75,510	
Central Area			
Trinity	93,130	77,563	Overdeveloped in some areas
Edwards (BFZ)	16,260	5,000	Overdeveloped in drought
Woodbine	1,590	2,432	Limited extent within region
Marble Falls	ND	4,183	Limited extent within region
Ellenburger-San Saba	ND	551	Limited extent within region
Hickory	ND	N/A[1]	Limited extent within region
Subtotal:	110,980	89,729	
Southeastern Area			
Brazos River Alluvium	24,850	66,700	Added potential, water quality variable
Carrizo-Wilcox	96,520	280,936	Large added potential
Queen City	2,280	3,459	
Sparta	1,880	10,333	Added potential
Gulf Coast	6,170	28,296	Added potential
Subtotal:	131,700	389,724	
Other and Undifferentiated	10,200	4,474	Many widely-scattered sources
Total:	327,100	559,437	

[1] ND indicates no data available from TWDB; NA indicates not determined.

remained fairly constant. Also in the west, the fringes of three aquifers, the Dockum, Blaine, and Edwards-Trinity (Plateau), extend into the planning area, but these offer little room for further development. In the northeastern part of the region, there is a wide area with no aquifers. In this area, which includes the counties of Throckmorton, Young, Shackelford, Stephens, and Palo Pinto, groundwater is available only for individual homes and livestock.

In the central part of the BGRWPA, the Trinity Aquifer is the most significant. It is widespread and furnishes small to moderate amounts of groundwater to entities in 17 counties. In the artesian portions of the aquifer, however, development has resulted in significant declines in the water table.

In the southeastern part of the region, the most significant aquifer is the Carrizo-Wilcox. The Carrizo-Wilcox has significant potential for further development, and the Gulf Coast Aquifer has moderate potential. Several minor aquifers also have potential for further development over wide areas in this sector. Most of the BGRWPA's undeveloped groundwater lies in the southeastern sector.

The Trinity Aquifer and all other artesian aquifers to the southeast have outcrop areas under water-table conditions and downdip areas with overlying confining layers where artesian conditions occur. Most of these aquifers contain fresh water to considerable depths, and all contain slightly saline water just downdip, which is commonly to the southeast, of the fresh water. Maps in Appendix B show the locations of fresh water, defined as containing less than 1,000 milligrams per liter (mg/L) total dissolved solids (TDS), and slightly saline water, defined as having 1,000 to 3,000 mg/L TDS, within various aquifers. Maps are included for all aquifers within the BGRWPA that have sustainable yield exceeding 5,000 acft/yr. The use of aquifers with groundwater containing more than 1,000 mg/L TDS is an option only where consumers can use the saline water or where special treatment is available. More detailed descriptions of each aquifer in the BGRWPA are in Appendix B.

1.3.1.2 Major Springs

The BGRWPA contains a few major springs. There are springs with flows greater than 1 cubic foot per second (cfs) that issue from the Edwards-Balcones Fault Zone (BFZ) Aquifer in Bell and Williamson Counties and from the Marble Falls Aquifer in Lampasas County. Of the Edwards Aquifer springs, all but one are intermittent. The three largest Edwards springs are:

1. Salado Springs at Salado along the Lampasas River with flow ranging from 5 to 60 cfs.
2. Berry Springs 5 miles north of Georgetown with flow ranging from 0 to 50 cfs.
3. San Gabriel Springs at Georgetown with flow ranging from 0 to 25 cfs.

Springs from the Marble Falls Aquifer include Hancock Park Springs along the Sulfur River, which is a tributary to the Lampasas River, with flow reportedly ranging from 6 to 12 cfs, and Swimming Pool Springs at Hancock Park with a reported range in flow of 1.3 to 1.6 cfs.

Some springs in the region that significantly affect the quality of the water in the Brazos River. These are primarily the salt springs and seeps, such as Salt Croton and Croton Creeks, in the upper Brazos River Basin. These natural saltwater sources cause the water in the main stem of the Brazos River above Possum Kingdom Lake to be too saline for most uses. For example, from 1963 to 1986, TDS and chloride concentrations in Croton Creek near Jayton averaged 7,933 mg/L and 3,169 mg/L respectively. The mean values for TDS and chlorides in the Salt Croton Creek near Aspermont from 1969 to 1977 were 71,237 mg/L and 41,516 mg/L respectively. Water in Possum Kingdom Lake usually contains more than 400 mg/L chloride and 1,200 mg/L TDS. The natural chloride pollution in the upper Brazos River affects water quality in the lower basin. In the Brazos River at Richmond, it has been estimated that 85 percent (or about 95 mg/L for the years 1946 to 1986)[7] of the chloride is from the upper basin.

There are many smaller springs in the Brazos G Region, but cataloging is inconsistent and incomplete. Only a few small springs have been cataloged in just nine of the 37 counties in the BGRWPA.[8] These springs flow substantially less than 1 cfs, and most flow only a few gallons per minute.

1.3.2 Surface Water

The BGWRPA lies within the Brazos River Basin, the boundaries of which are the Red River Basin to the north, the Colorado River Basin to the west, the Trinity and San Jacinto River Basins to the east, and the counties of Fayette, Austin, Waller, and Montgomery to the south. The total drainage area for the Brazos River Basin is about 45,400 square miles, and of this about 28,400 square miles are in the BGRWPA.

The Brazos River is the third-largest river in Texas and the largest river between the Rio Grande River and the Red River in terms of total watershed area.[9] The Brazos River rises in three upper forks: the Double Mountain Fork, Salt Fork, and Clear Fork. Twenty-nine major

[7] Ganze, C. Keith and Ralph A. Wurbs, “Compilation and Analysis of Monthly Salt Loads and Concentrations in the Brazos River Basin,” U.S. Army Corps of Engineers, Contract No. DACW63-88-M-0793, January 1989.
[8] Brune, Gunnar, *Major and Historical Springs of Texas: TWDB Report 189*, 1970.
[9] The Dallas Morning News, *1998-1999 Texas Almanac*, 1997.

reservoirs provide surface water to the BGRWPA. Major reservoirs are defined as having an authorized capacity greater than 10,000 acft, and these are listed in Table 1-5. This table shows amounts of storage and diversion that the Texas Natural Resource Conservation Commission (TNRCC) authorizes for each reservoir. Figure 1-2 shows locations of some of the reservoirs in the Brazos G Region, and Table A-5 in Appendix A provides more detailed information about all reservoirs in the BGRWPA with a permitted capacity greater than 2,500 acft. Diversions permitted for municipal, industrial, irrigation, and mining uses for each BGRWPA sub-region are in Table 1-6. Diversion permitted for these uses in each BGWRPA county are given in Table A-6 in Appendix A.

1.4 Water Providers

1.4.1 Authorities

1.4.1.1 Brazos River Authority

The primary provider of water to the Brazos G regions is the Brazos River Authority. The BRA also operates water and wastewater treatment systems, has programs to assess and protect water quality, does water supply planning, and supports water conservation efforts in the Brazos River Basin. BRA provides water from three wholly owned and operated reservoirs in the region: Lake Granbury, Possum Kingdom Lake, and Lake Limestone. BRA also contracts for conservation storage space in the nine U.S. Army Corps of Engineers reservoirs in the region: Lakes Waco, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Somerville, Whitney, and Aquilla. The total permitted capacity of these 12 reservoirs in the BRA system is approximately 2.3 million acft. BRA holds rights for diversion in the region totaling more than 662,000 acft, and contracts to supply water to municipal, industrial, and agricultural water customers in the BGRWPA and other regions. BRA’s largest municipal customers in 1999 included Bell County Water Control and Improvement District No. 1, the City of Round Rock, and the Central Texas Water Supply Corporation.

1.4.1.2 Lower Colorado River Authority

The Lower Colorado River Authority (LCRA) provides raw water to the City of Cedar Park from Lake Travis in Travis County (SB1 planning region K). The BRA and the LCRA

Table 1-5.
Major Reservoirs in BGRWPA
(Authorized Capacity Greater than 10,000 acft)

Reservoir	Stream	County	Authorized Storage (acft/yr)	Authorized Diversion (acft/yr)	Owner
Abilene	Elm Creek	Taylor	11,868	1,675	City of Abilene
Alcoa Lake	Sandy Creek	Milam	15,650	14,000	Aluminum Co. of America
Aquilla	Aquilla Creek	Hill	52,400	13,896	U.S. Army Corps of Engineers
Belton	Leon River	Bell	457,600	100,257	U.S. Army Corps of Engineers
Cisco	Sandy Creek	Eastland	45,000	2,027	City of Cisco
Cleburne[1]	Nolan Creek	Johnson	25,600	6,000	City of Cleburne
Daniel	Gonzales Creek	Stephens	11,400	2,100	City of Breckenridge
Dansby Power Plant	Unnamed Trib. Brazos River	Brazos	15,227	850	City of Bryan
Fort Phantom Hill[1]	Elm Creek	Jones	73,960	30,690	City of Abilene
Georgetown	North Fork San Gabriel River	Williamson	37,100	13,610	U.S. Army Corps of Engineers
Gibbons Creek	Gibbons Creek	Grimes	32,084	9,740	Texas Municipal Power Agency
Graham/Eddleman	Flint Creek	Young	52,386	20,000	City of Graham
Granbury	Brazos River	Hood	155,000	64,712	Brazos River Authority
Granger	San Gabriel River	Williamson	65,500	19,840	U.S. Army Corps of Engineers
Hubbard Creek	Hubbard Creek	Stephens	317,750	52,800	West Central Texas MWD
Leon	Leon River	Eastland	28,000	6,301	Eastland Co. WSD
Limestone	Navasota River	Robertson	225,400	65,450	Brazos River Authority
Palo Pinto[1]	Palo Pinto Creek	Palo Pinto	44,124	18,500	Palo Pinto MWD
Possum Kingdom	Brazos River	Palo Pinto	724,739	230,750	Brazos River Authority
Proctor	Leon River	Comanche	59,400	19,658	U.S. Army Corps of Engineers
Somerville	Yegua Creek	Washington	160,110	48,000	U.S. Army Corps of Engineers
Squaw Creek	Squaw Creek	Somervell	151,500	23,180	Texas Utilities Electric Co.
Stamford	Paint Creek	Haskell	60,000	10,000	City of Stamford
Stillhouse Hollow	Lampasas River	Bell	235,700	67,768	U.S. Army Corps of Engineers
Tradinghouse	Tradinghouse Creek	McLennan	37,800	27,000	Texas Utilities Electric Co.
Truscott Brine	Bluff Creek	Knox	107,000	N/A	Red River Authority of Texas
Twin Oak	Duck Creek	Robertson	30,319	13,200	Texas Utilities Electric Co.
Waco	Bosque River	McLennan	104,100	59,100	U.S. Army Corps of Engineers
Waco Enlargement			87,962	20,770	U.S. Army Corps of Engineers
Whitney	Brazos River	Hill	50,000	18,336	U.S. Army Corps of Engineers
Totals	—	—	3,474,679	980,210	—

[1] Data acquired from TNRCC.

Table 1-6.
Permitted Surface Water Diversions by Subregion

Sub-Region	Permitted Diversion (acft/yr)[1]					
	Municipal	Industrial	Irrigation	Mining	Other[2]	Total
Rolling Plains[3]	491,583	270,177	88,430	26,321	1,305	877,816
IH-35 Corridor[4]	576,828	81,684	18,498	603	270	677,883
Lower Basin	129,652	164,073	48,850	200	127	342,902
Region Total	1,198,063	515,934	155,778	27,124	1,702	1,898,601

[1] Available supply may be less than the permitted diversion based on hydrologic conditions and priority of individual water rights.
[2] Category includes hydroelectric, navigation, recreation, and other uses as classified by the TNRCC.
[3] 1,534,000 acft of industrial water in the Rolling Plains sub-region is non-consumptive for the Fort Phantom Hill Power Station.
[4] 1,257,530 acft of other water in the IH-35 Corridor sub-region is non-consumptive for hydroelectric power generation.

have formed the Brazos-Colorado Water Alliance to identify water supply and treatment alternatives to meet the future needs of the Brazos and Colorado River Basins.

1.4.2 Districts

1.4.2.1 Bell County WCID No. 1

Bell County WCID No. 1 obtains raw water from Lake Belton for distribution to its customers. Major customers include the U.S. Department of the Army and the cities of Belton, Copperas Cove, Harker Heights, and Killeen.

1.4.2.2 West Central Texas Municipal Water District

The West Central Texas Municipal Water District gets raw water from Hubbard Creek Reservoir, which it owns and operates, for distribution to the cities of Abilene, Albany, Anson, and Breckenridge. This district has rights to 56,000 acft of water for municipal, industrial, irrigation, and mining uses.

1.4.3 Municipal

1.4.3.1 City of Abilene

The City of Abilene obtains raw water from Lake Fort Phantom Hill, Lake Abilene, and Lake Kirby, all of which it owns and operates. The total permitted capacity of these reservoirs is about 94,300 acft. The City has the right to divert up to 37,365 acft/yr from these lakes for municipal, industrial, and irrigation uses. The City also uses self-supplied groundwater and surface water purchased from the West Central Texas Municipal Water District. In 1996, the City sold treated water to 10 entities in the BGRWPA, the largest of which was Dyess Air Force Base. The City of Abilene used about 24,000 acft of water in 1996.

West Texas Utilities Company operates a power-generating facility on Lake Fort Phantom Hill and has the right to divert up to 1,534,000 acft/yr for non-consumptive recirculating cooling use.

1.4.3.2 City of Waco

The City of Waco obtains raw water from Lake Waco. The City has the right to divert 59,100 acft/yr for municipal and irrigation uses. The City, in cooperation with BRA, is currently implementing a project to enlarge Lake Waco that will provide for an additional 20,770 acft/yr of supply. In 1996, the City provided roughly 26,770 acft of treated water to its citizens and to the Cities of Hewitt, Lacy-Lakeview, and Woodway.

1.4.3.3 City of Round Rock

The City of Round Rock obtains raw water from the Edwards (BFZ) Aquifer and purchases additional water from Lake Georgetown. The City provided about 12,556 acft to its citizens in 1996. The City also sells water to four other entities in the region. Its largest customer, Brushy Creek MUD, bought 1,895 acft in 1996. The City has contracted to purchase 18,134 acft/yr from the BRA at Stillhouse Hollow Reservoir in Bell County. The pipeline that will deliver this water to Lake Georgetown is scheduled to be completed by the end of 2001.

1.4.3.4 City of Temple

The City of Temple obtains raw water primarily from the Leon River, to which it holds a run-of-the-river permit. This permit from the TNRCC gives the City the right to divert water from the river but not to store it. The City also has contracted for stored water from BRA in Lake Belton. In 1996, the City provided about 12,700 acft of water to its own citizens and to the Cities of Morgans Point and Troy.

1.4.3.5 City of Killeen

The City of Killeen obtains water from Lake Belton through Bell County WCID No. 1, and it obtains additional water from Nolan Creek, to which it holds diversion rights. In 1996, the City of Killeen used 10,212 acft.

1.4.3.6 City of Bryan

The City of Bryan obtains raw water from the Carrizo-Wilcox Aquifer. The City distributed about 10,300 acft in 1996. About 100 acft were sold to the Wellborn Special Utility District.

1.4.3.7 City of College Station

The City of College Station also obtains its water from the Carrizo-Wilcox Aquifer, and it used about 17,258 acft in 1996. The City sold about 600 acft to the Wellborn Special Utility District.

1.4.3.8 City of Georgetown

The City of Georgetown obtains raw water from the Edwards (BFZ) Aquifer. It also purchases water from Lake Georgetown from the BRA. In 1996, the City purchased about 6,700 acft of raw water and distributed about 2.400 acft. The City has contracted to purchase 15,448 acft/yr from the BRA at Stillhouse Hollow Reservoir in Bell County. The pipeline that will deliver this water to Lake Georgetown is scheduled to be completed by the end of 2001.

1.4.3.9 City of Sweetwater

The City owns and operates two reservoirs, Lake Sweetwater and Lake Trammel. However, the City's primary source of water is the Oak Creek Reservoir in Coke County (SB1 planning region F) in the Colorado River Basin. In 1996, the City sold 5,400 acft of water to its citizens and to other BGRWPA entities.

1.4.3.10 City of Cedar Park

In 1996, the City of Cedar Park purchased all of its water from the LCRA and the City of Austin (SB1 planning region K). The City sold about 3,141 acft to its citizens and 800 acft to other entities in 1996. The City's largest customer was the Williamson-Travis MUD No. 1.

1.4.4 Others

1.4.4.1 Texas A&M University

Texas A&M University obtains raw water from the Carrizo-Wilcox Aquifer and treats it at the College Station campus. The University used about 6,820 acft of water in 1996. The

University also has a contract with the BRA for rights to raw water in Lake Limestone totaling 6,945 acft.

1.4.4.2 U.S. Department of the Army

The U.S. Department of the Army has a water right to store and divert 12,000 acft in Lake Belton and the yield available from this right is estimated to be about 3,336 acft. The Army has contracted with Bell County WCID No. 1 and the City of Gatesville to divert, treat, and deliver this water to Fort Hood.

1.4.4.3 Central Texas Water Supply Corporation

Central Texas Water Supply Corporation contracts with the BRA to obtain raw water from Lake Stillhouse Hollow. This provider sold a total of 6,500 acft of treated water to 16 other water-supply entities in 1996. Its largest customer was Kempner Water Supply Corporation, which purchased about 3,300 acft.

1.5 Current Water Users and Demand Centers

1.5.1 Regional Water Use

Total water use by each county in the Brazos G planning area is provided in Figure 1-12 for 1996. Water use can be better understood by looking at four general types of use: municipal, industrial, agricultural, and non-consumptive. Figure 1-13 shows historical water consumption for municipal, industrial, and agricultural use in the BGRWPA. Industrial use can be further broken down into three sub-categories: manufacturing, steam-electric cooling, and mining. Agricultural use comprises the subcategories of water used for irrigation and livestock. Table 1-7 summarizes historical water use in the planning area for six such categories. Each category is defined below. In Appendix A, Table A-7 gives historical water-use data for all counties in the BGRWPA, and Table A-8 gives historical water-use data by category of use. Water use, greater than or equal to 1,000 acft, by each water-right holder is given in Appendix D. A complete list of water rights for the planning area is in Appendix G.

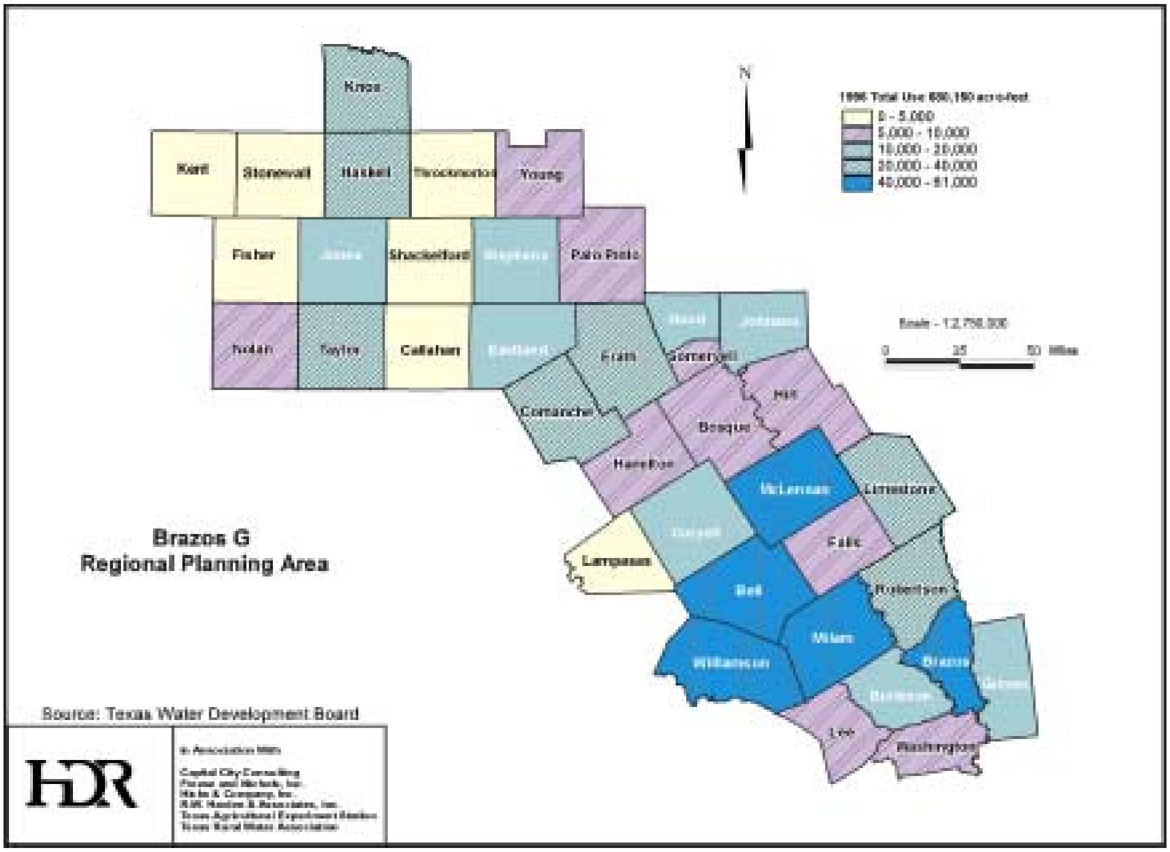

Figure 1-12. 1996 Total Water Use by County

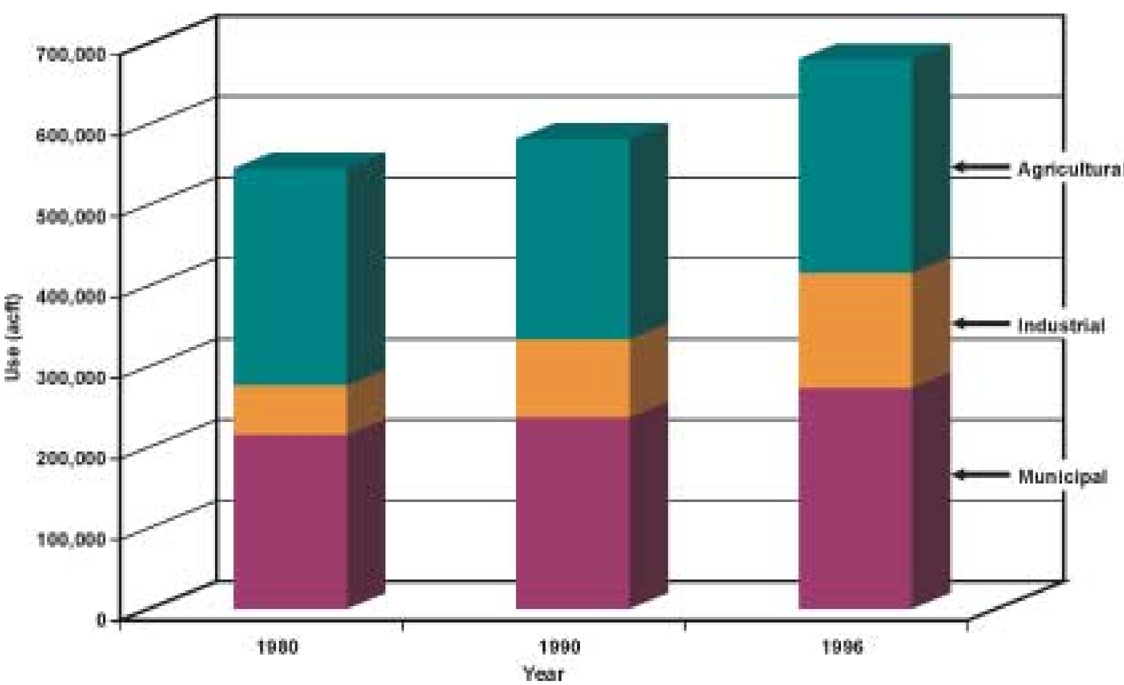

Figure 1-13. BGRWPA Historical Water Use by Type

Table 1-7.
BGRWPA Historical Water Use[1] (acft/yr)

Category	1980	1990	1996
Municipal Use	215,744	236,955	273,887
Manufacturing Use	21,124	32,240	55,647
Steam-Electric Use	28,686	57,657	69,118
Mining Use	11,413	6,944	17,387
Irrigation Use	229,387	200,954	198,687
Livestock Use	38,915	46,770	65,424
Total Use	545,269	581,520	680,150
Percent of State Total	**3.06**	**3.70**	**4.05**

[1] Historical data obtained from TWDB.

1.5.2 Municipal Use

Municipal water use includes water consumed for residential and commercial enterprises and institutions. Residential and commercial uses are categorized together because they are similar types of uses (i.e., they both use water primarily for drinking, cleaning, sanitation, air-conditioning, and landscape watering). Municipal use does not include water use by industries. Projections for future municipal use take into account population growth and anticipated efforts at water conservation. Municipal use of 273,887 acft accounted for about 40 percent of the region's total water use in 1996. Figure 1-14 shows municipal water use in each BGRWPA county in 1996.

1.5.3 Industrial Use

Industrial use consists of water used for manufacturing, for steam-electric cooling during power generation, and for mining operations. Projections for industrial use take into account expected growth of industries, population changes, available mineral reserves, and production rates. In 1996, industrial use was 142,152 acft, or about 21 percent of the total water used in the BGRWPA. Refer to Figure 1-15 for 1996 industrial water use by county.

1.5.3.1 Manufacturing

Manufacturing use is water used for producing finished goods. Manufacturing use was 55,647 acft in 1996, or 39 percent of total industrial water usage that year.

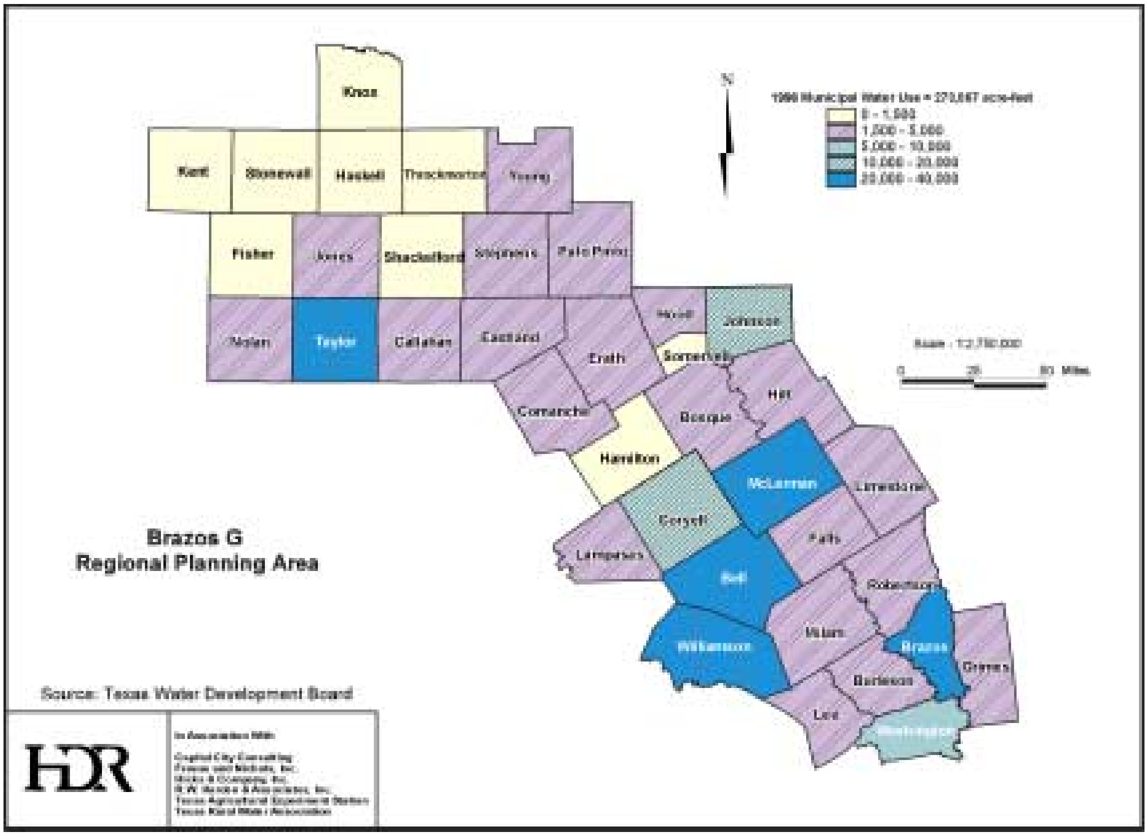

Figure 1-14. 1996 Municipal Water Use

1.5.3.2 Steam-Electric Cooling

This category is water used during the power-generation process and is typically losses due to evaporation during cooling. Water that is diverted and not consumed (i.e., return flow) is not included in the power-generation total. Water use for steam-electric cooling in 1996 was 69,118 acft, or 49 percent of total industrial water use.

1.5.3.3 Mining

Mining use is water consumed for exploration and production of oil and gas, and for mining of lignite, sand, gravel, and such. Mining use in 1996 was 17,387 acft, or 12 percent of the total industrial water use.

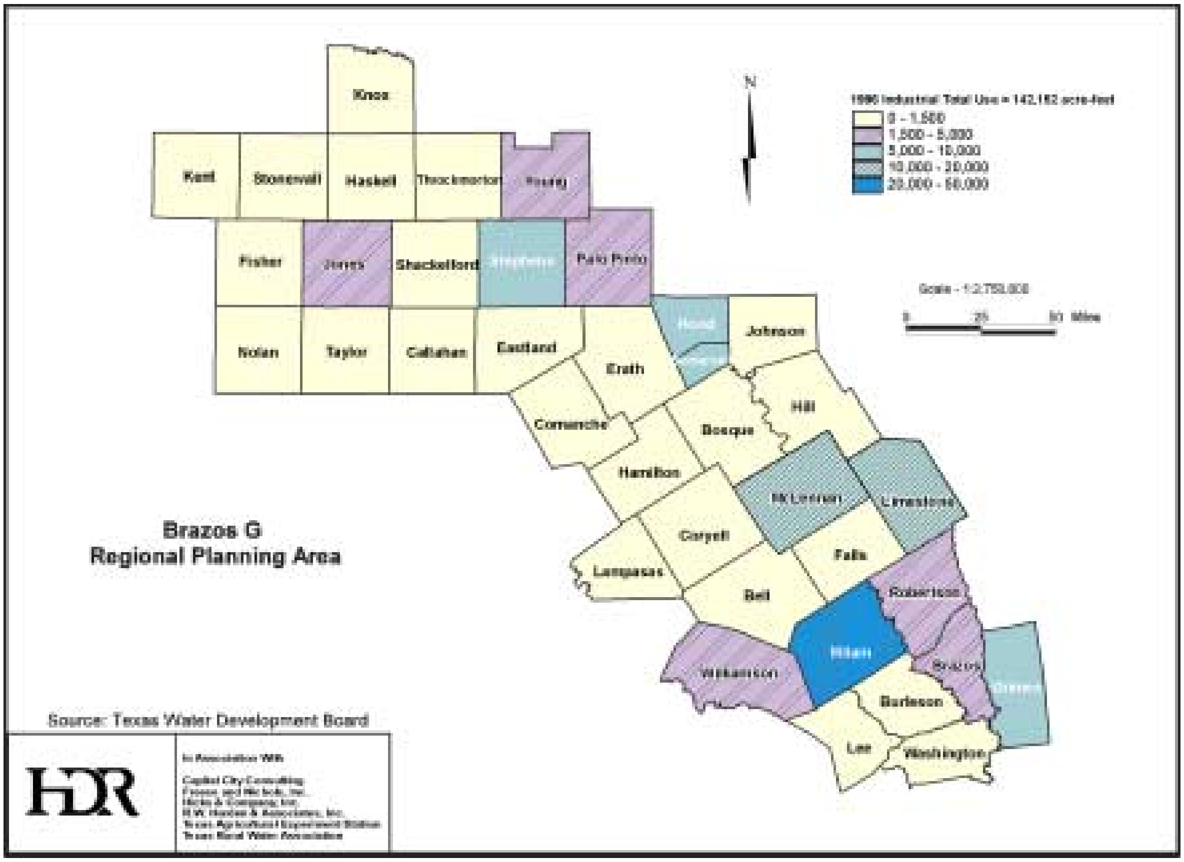

Figure 1-15. 1996 Industrial Water Use (Manufacturing, Steam-Electric Cooling, and Mining)

1.5.4 Agricultural Use

Agricultural use is water used for irrigation and for watering livestock. Agricultural use was 264,111 acft in 1996, or 39 percent of the BGRWPA's total water use. Refer to Figure 1-16 for agricultural water use by each county in the planning area in 1996.

1.5.4.1 Irrigation

Irrigation use in 1996 totaled 198,687 acft, or about 75 percent of the total agricultural water use. Refer to Appendix G for more detailed information about irrigation use in the BGRWPA.

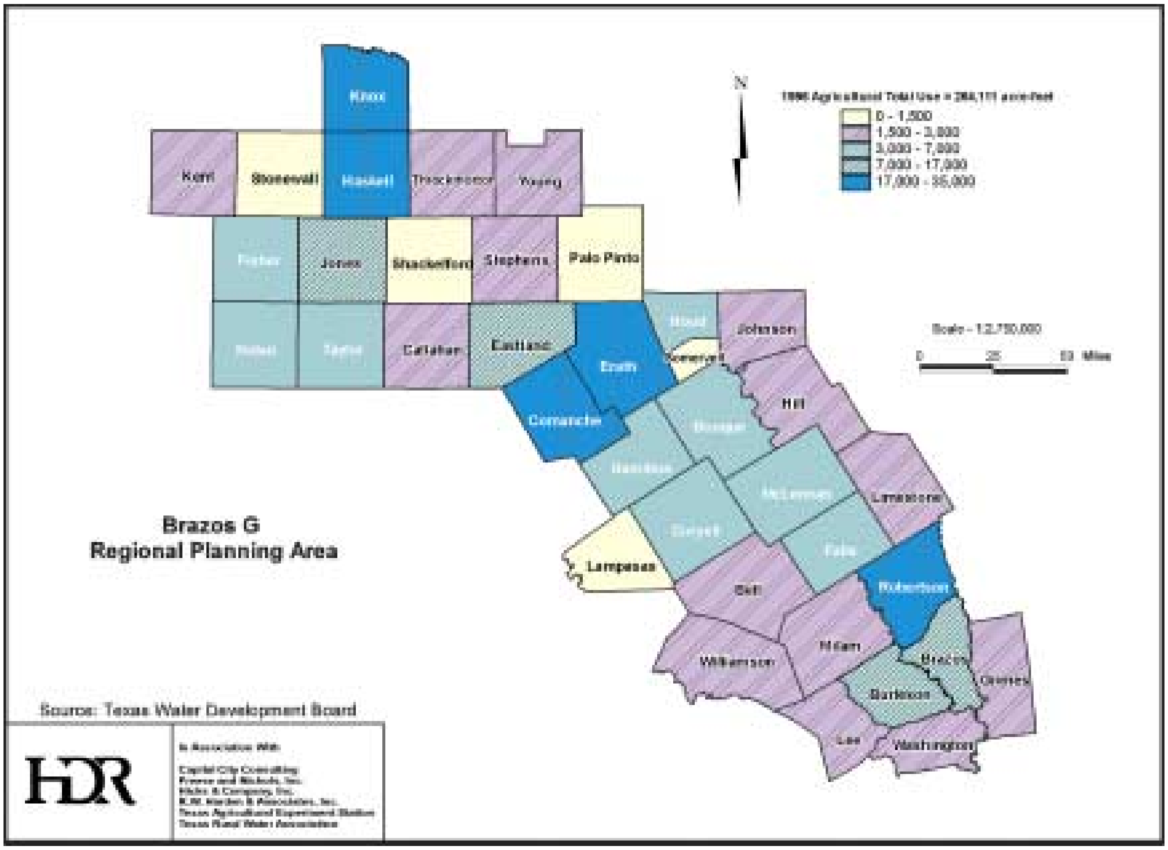

Figure 1-16. 1996 Agricultural Water Use (Livestock and Irrigation)

1.5.4.2 Livestock Watering

The estimate of use for livestock watering is based on a determination of the total number of livestock in the region. A uniform water-consumption rate for each type of animal is applied to this total number.[10] The categories of livestock considered are cattle and calves; poultry; sheep and lambs; and hogs and pigs. Livestock watering totaled 65,427 acft, or 25 percent of agricultural use in 1996. Refer to Appendix G for more detailed information on water used for livestock.

1.5.5 Non-Consumptive Use

The majority of non-consumptive water use is recreational use and the return flow from power generation. Water-related recreational activities include boating, camping, fishing, and

[10] TWDB, *Water for Texas*, August 1997.

swimming. Recreational use in the BGRWPA is supported by numerous state parks and by public facilities for boating and camping at various lakes and reservoirs along the Brazos River.

Power generation demands large amounts of water for cooling equipment. Fifteen steam-electric power-generating facilities were operating in the BGRWPA in 1996. Most of the diverted water was returned to the Brazos Basin, but some was lost to evaporation during the cooling process.

1.6 Natural Resources

1.6.1 Regional Vegetation

The BGRWPA lies within several different vegetational areas, or ecoregions, as defined by Gould.[11] Figure 1-17 shows the locations of these ecoregions, which are relatively homogenous areas in terms of geography, hydrology, and land use. The five ecoregions in the BGRWPA are the Rolling Plains, Blackland Prairies, Post Oak Savannah, Cross Timbers and Prairies, and Edwards Plateau. A general description for each ecoregion is provided below. More detailed information is provided in Appendix E.

1.6.1.1 Rolling Plains

The Rolling Plains are part of the Great Plains of the central United States. The Rolling Plains region covers about 24 million acres of gently rolling to moderately rough terrain. The region is bordered on the west by the Caprock Escarpment, on the south by the Edwards Plateau, and on the east by the Cross Timbers and Prairies region. Annual precipitation averages about 22 to 30 inches, and elevations range from 800 to 3,000 feet above sea level. The eastern part of the Rolling Plains is called the Reddish Prairie. Soils vary from coarse sands in outwash terraces near streams to tight clays or red-bed clays and shales.

1.6.1.2 Blackland Prairies

The Blackland Prairies region consists of nearly level to gently rolling topography. It covers about 11.5 million acres from Grayson and Red River Counties in northeast Texas to Bexar County in the south-central part of the State where it merges with the brushland of the Rio Grande Plains. Annual precipitation is 30 to 45 inches, and elevations range from 300 to

[11] Gould, F.W., *The Grasses of Texas*, Texas A&M University Press, College Station, Texas, 1975.

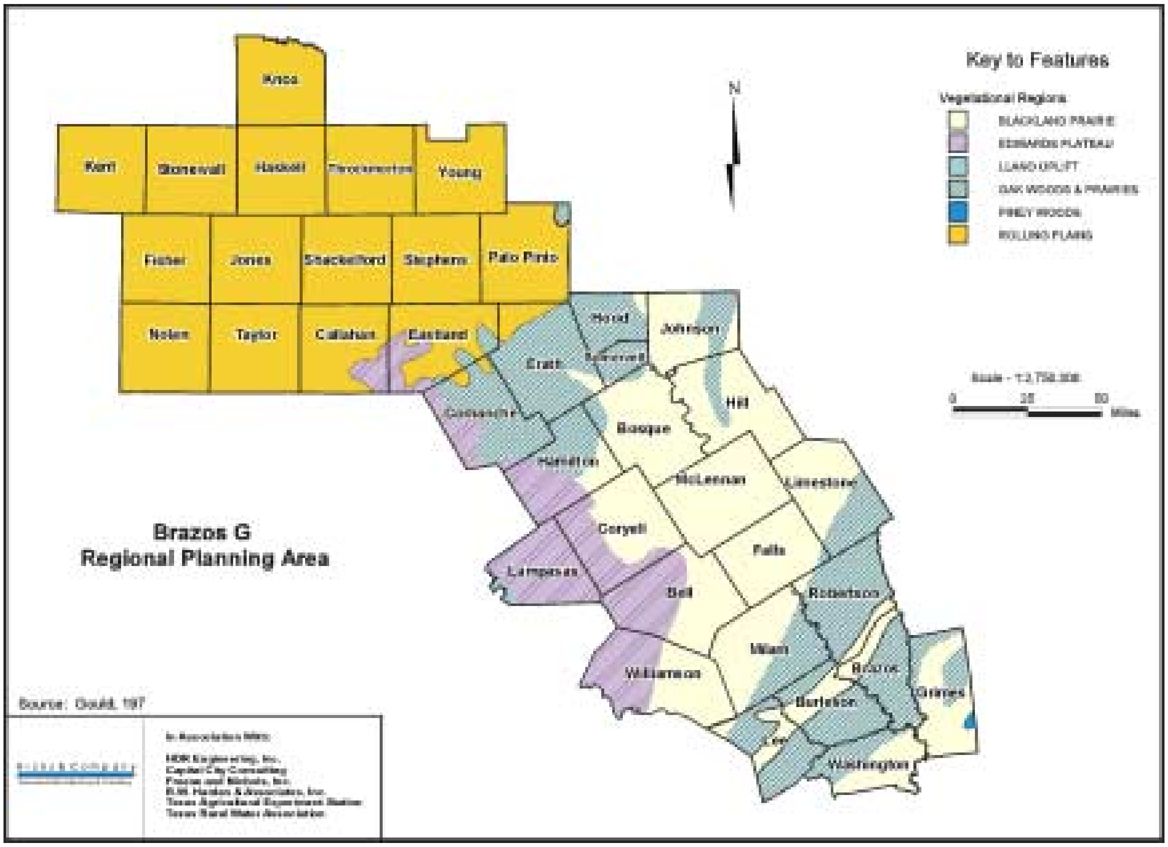

Figure 1-17. Vegetational Areas of the Brazos G Region

800 feet above sea level. The term blackland comes from the uniformly dark-colored, calcareous clays in the Alfisols (fertile mineral soils). Soils in the Blackland Prairies are interspersed with gray-colored, acidic sandy loams. This highly fertile region has widely been used for agriculture, but it is increasingly used for ranching.[12] Experts estimate that less than one percent of the Blackland Prairies _ in a near-natural condition.[13]

1.6.1.3 Post Oak Savannah

The Post Oak Savannah covers about 8.5 million acres in east-central Texas and consists of closely associated and intermingled prairies and woodlands on slightly acidic sandy or clay loams. Topography in this region is gently rolling to hilly, with moderate to deeply dissected drainage paths. Soils in uplands are generally light-colored, acidic sandy loams or sands, and

[12] Gould, F.W. and Schuster, J.L. and Hatch, S.L., *Texas Plants B, An Ecological Summary*, Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas, 1990.
[13] Smeins and Diamond, 1986.

soils in bottomlands are light-brown to dark-gray acidic sandy loams or clays. Much of this vegetational area is used for crops and grazing.

1.6.1.4 Cross Timbers and Prairies

The Cross Timbers and Prairies vegetational area covers about 17 million acres in north-central Texas. Geology in this area is diverse, and the topography varies from gently rolling to hilly to deeply dissected. Rapid surface drainage is typical throughout the region. Soils are typically brown, neutral-to-slightly acidic, sandy or clay loams.

1.6.1.5 Edwards Plateau

The Edwards Plateau area covers about 24 million acres. This includes a large portion of the Hill Country in west-central Texas, the Llano Uplift, and the Stockton Plateau. Average annual precipitation increases from west to east across this region. Limestone or caliche typically underlie the shallow, variably-textured soils, although granitic rock underlies soil in the Llano Uplift. Land use in this vegetational area is dominated by ranching of cattle, sheep, and goats. This region reportedly once was dominated by a grassland or an open savannah climax community, except in steep canyons and slopes where junipers and oaks were dominant. The widespread disturbance associated with grazing livestock eventually allowed brush and tree species to spread widely throughout the original grasslands and savannahs.

1.6.2 Regional Geology

Figure 1-18 shows the varied geology of the planning area. Generally, the formations in the northwest part of the planning area are the older Blaine and San Angelo Formations of the Paleozoic era. The central part of the planning area is typically dominated by younger formations from the Cretaceous era, such as the Trinity Group; the Navarro and Taylor Groups; and the Austin, Eagle Ford, Woodbine, and U. Washita Groups. The youngest formations are in the southern part of the planning area. These formations include the Cook Mountain, Weches, Sparta, and Yegua, among others. Many areas near streams and rivers are dominated by alluvial deposits.

1.6.3 Soils

The soils of the upper Brazos River Basin are agriculturally and ecologically important. Throughout Brazos G Region, soils are varied and are influenced by both geology and surface drainage. Figure 1-19 shows the locations of different orders of soil in the BGRWPA. These soil types are briefly described in the following subsections.

1.6.3.1 Alfisols

Alfisols are mineral soils with a gray-to-brown surface horizon. These soils form under humid, cool-to-hot areas of native grasslands. They are productive and favor good crop yields.

1.6.3.2 Entisols

Entisols are typical of rangeland in west and southwest Texas. In this order, soils range from infertile sands and bedrock to highly productive soils on recent alluvium. A characteristic common to all Entisols is the lack of significant profile development.

1.6.3.3 Inceptisols

Inceptisols are thought to form relatively quickly from the alteration of parent material. Productivity varies among soils in this order, and it is affected by factors such as levels of organic matter and drainage. Typically, Inceptisols have slightly higher profile development than Entisols.

1.6.3.4 Mollisols

Mollisols are considered important agriculturally and are characterized by a thick, dark **surface horizon**. These soils develop under grassland-prairie vegetation typical of the central United States. Mollisols cover more land area in the United States than any other soil order.

1.6.3.5 Vertisols

Vertisols have a high clay content and therefore may develop deep cracks from shrinking during dry periods. The fine texture of Vertisols and their tendency to shrink excessively makes them generally unstable for building foundations and even for some agricultural uses.

1.6.4 Wetlands

Wetlands are defined by the U.S. Army Corps of Engineers as areas that, due to a combination of hydrologic and soil conditions, are capable of supporting hydrophytic vegetation. In the Brazos G Region, wetlands are found primarily in narrow strips along rivers and streams.

As a natural resource, wetlands are especially valued because of their location on the landscape, the wide variety of ecological functions they perform, and the uniqueness of their plant and animal communities. Many wetlands are also valued for their aesthetic qualities, as sites for educational research, as sites of historic and archaeological importance, and as locations for conveying floodwaters. Wetlands provide high-quality habitats for wildlife, including foraging and nesting areas for birds and spawning and nursery areas for fish.

1.6.5 Water Resources

Rivers and reservoirs are also important ecological resources for the Brazos G Region. These support diverse aquatic plants and animals as well as terrestrial wildlife living along the banks. Important rivers and creeks in the planning area include the Brazos, Leon, Bosque, Lampasas, San Gabriel, South Wichita, Little, Clear Fork of the Brazos, and Yegua Creek. These rivers contribute to unique vegetational communities that provide habitat for wildlife. There are more than 40 species of aquatic amphibians, reptiles, and mammals in the planning area. Waterfowl heavily use the mature, hardwood, bottomland forests and forested wetlands often associated with rivers. Aquatic habitats include riffles and pools, which support both invertebrates and fish.

Reservoirs (Figure 1-20) provide habitat for inland fish stocks and waterfowl. Reservoirs in the planning area that are important habitats for fish stocks and waterfowl include Lake Stamford, Hubbard Creek Reservoir, Possum Kingdom Lake, Lake Leon, Lake Proctor, Lake Whitney, Lake Stillhouse Hollow, Lake Belton, Lake Waco, and Lake Somerville.

Although few in number, those major springs and seeps in the planning area that produce frequent flows are often rich in wildlife habitat and ecological diversity. Springs represent a transition from groundwater to surface water. Where frequent springflow occurs, an abundance of moisture is provided, resulting in diverse vegetational communities unique to such areas. Typical vegetation includes willows, cottonwoods, hackberry, elms, rushes, sedges, and smartweed. These vegetational communities often provide optimal habitat for native wildlife.

1.6.6 Wildlife Resources

1.6.6.1 Biotic Provinces

Just as Gould[14] described the major plant zones of Texas, Blair[15] classified the State into biotic provinces based on the distribution of topographic features, climate, vegetation types, and terrestrial vertebrates (Figure 1-21). The BGRWPA includes the Kansan, Austroriparian, Balconian, and Texan biotic provinces.

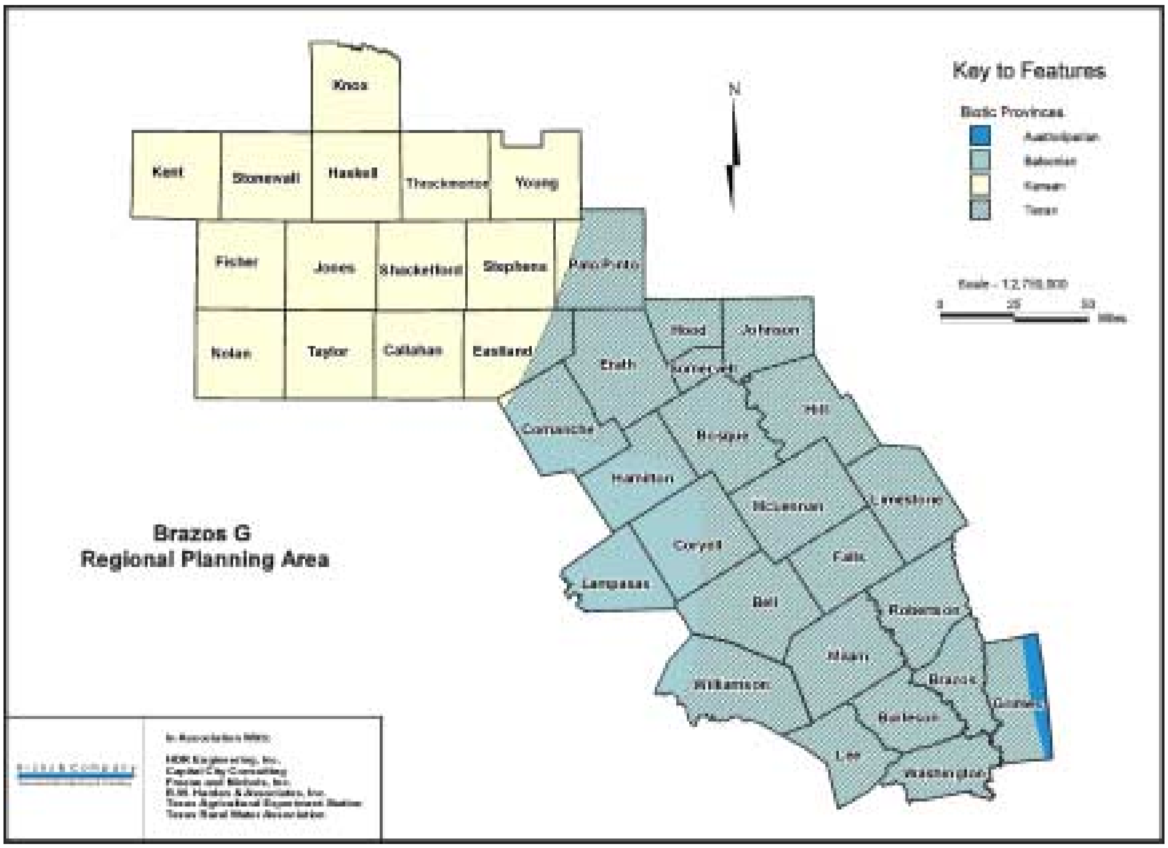

Figure 1-21. Biotic Provinces of the Brazos G Region

1.6.6.1.1 Kansan

The Kansan province runs southward from the Texas panhandle and across the Rolling Plains area of the Brazos G Region. It meets the Texan biotic province at the western boundary of the Cross Timbers and Prairies vegetational area. There is little available moisture in the

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[14] Gould, Op. Cit., 1975.
[15] Blair, 1950.

province, and moisture that is available decreases from east to west. The plant associations vary. However, they fall into three general categories of associations: the mixed-grass plains, the mesquite-grass association, and the short-grass plains.

1.6.6.1.2 Austroriparian

The western fringe of the Austroriparian province extends into the southeastern rim of the Brazos G Region. This province comprises the pine and hardwood forests of the eastern Gulf Coastal plain. The province is limited to the west due to low moisture. However, vegetational communities found in the westward extensions of the province occur along drainageways where environmental conditions allow.

1.6.6.1.3 Balconian

The Balconian province includes most of the Edwards Plateau excluding the region west of the Pecos River. The Edwards Plateau is a physio-graphically discrete unit. It has a variety of wildlife, and its vegetation is different from that found in adjacent provinces. The abundant vertebrate species are a mixture of Austroriparian, Tamaulipan, Chihuahuan, and Kansan.

Most of the Balconian province lies on Cretaceous limestone, but igneous intrusives and sediments of Precambrian age are exposed in the Llano Uplift. Limestone caverns and springs are common features of this province. Massive outcrops of limestone are characteristic of the stream canyons, and limestone fragments occur at the surface over almost the entire area.

Rainfall amounts typically decrease from east to west. The most characteristic plant association is the juniper-oak scrub. Mesquite is also distributed throughout the province.

1.6.6.1.4 Texan

The Texan biotic province has no true endemic species of vertebrates. In this area, western species tend to encroach into open habitats, and eastern species encroach along the many wooded drainageways extending through the landscape. The Texan province has supported 49 species of mammals, 39 species of snakes, 16 species of lizards, 2 types of land turtles, 18 types of toads and frogs (anurans), and 5 species of salamander (urodeles).

1.6.6.2 Threatened and Endangered Species

In planning water-management strategies, one major consideration is the potential impact on threatened and endangered species. Nineteen of the species listed as threatened or endangered by the U. S. Fish and Wildlife Service are found in the Brazos G planning area. Some of the more widely seen of these are the golden-cheeked warbler (*Dendroica chrysoparia*), the black-capped vireo (*Vireo atricapillus*), and the bald eagle (*Haliaeetus leucocephalus*). Table E-1 in Appendix E gives a complete list of threatened and endangered species in each county in the BGRWPA.

1.6.7 Agricultural Resources

Agriculture is a mainstay of the BGRWPA rural economy. Among livestock, cattle were the most significant component, approaching 2.5 million head with an additional 145,000 dairy cows in 1997. Over 17 million acres, or about 84 percent of BGRWPA's total area, were classified as farmland in 1997. Of the 17 million acres of farmland, about six million acres were classified as cropland, of which about three million acres were harvested. Refer to Tables F-1 through F-4 in Appendix F for detailed listings of agricultural information for the BGRWPA.

The Texas Department of Agriculture has specified several Agricultural Statistics Districts for the purpose of keeping records. The districts within the BGRWPA are 2N and 2S (Rolling Plains), 3 (Cross Timbers), 4 (Blacklands), 5S (South East), 7 (Lampasas County), and 8N (South Central).

1.6.7.1 Rolling Plains

Counties in the Rolling Plains (Districts 2N and 2S) are Fisher, Haskell, Jones, Kent, Knox, Nolan, Stonewall, and Taylor. The major dryland products are extensive row-crops, such as cotton, and wheat. Irrigation comes from the Seymour Aquifer where available. Major crops include wheat and cotton. Hay and silage are also produced, but because of low rainfall, their acreage is much less than in other districts in the BGRWPA.

1.6.7.2 Cross Timbers

The Cross Timbers counties (District 3) are Callahan, Comanche, Eastland, Erath, Hood, Palo Pinto, Shackelford, Somervell, Stephens, Throckmorton, and Young. Combined, these counties lead the State in dairy production. This is due to several factors such as available groundwater from the Trinity Aquifer, soils suitable for forage production, topography conducive to dairy operation, and an existing infrastructure. The major crops produced in the Cross Timbers are hay and silage, with smaller amounts of peanuts, pecans, and vegetables irrigated from the Trinity Aquifer.

1.6.7.3 Blacklands

The Blacklands counties (District 4) are Bell, Bosque, Coryell, Falls, Hamilton, Hill, Johnson, Limestone, McLennan, Milam, and Williamson. Lampasas County (District 7) is included for the purposes of this analysis. The Blacklands is noted for dryland production of corn for grain, grain sorghum, wheat for grazing and grain, cotton, and hay. Irrigation in the Blacklands is limited by lack of sufficient groundwater supply.

1.6.7.4 South East and South Central Texas

South East and South Central Texas counties (District 5S and 8N) are Brazos, Burleson, Grimes, Lee, Robertson, and Washington. This sub-region has limited row-crop agriculture because suitable topography and soils are limited. Hay and silage are the major agricultural products. The Brazos River Bottoms counties (Brazos, Burleson, and Robertson) produce most of the crops in the sub-region, including corn for grain, grain sorghum, and cotton. The Brazos River Alluvium is the major source of groundwater for the Brazos River Bottoms.

1.7 Threats and Constraints to Water Supply

Projected population growth in the region, particularly along the IH-35 Corridor, may strain existing municipal supplies. The population of Williamson County, for example, is expected to increase more than four-fold by the year 2050 to about 886,000 people. Water will become even more valuable, especially in the western and central parts of the BGRWPA, due to limited options for new reservoirs and because the aquifers in these areas have limited potential for further development.

Other concerns include the high content of chloride in surface-water runoff from the upper Brazos River Basin. Water with a high chloride content is expensive to treat and therefore places capital constraints on suppliers who obtain surface water from affected streams and reservoirs.

1.7.1 Susceptibility of Water Supplies to Drought

1.7.1.1 Groundwater

The 15 aquifers within the BGRWPA vary in drought resistance, but all tend to have more resistance than most surface-water reservoirs. Most of the thick, deep, and extensive sand aquifers with moderate to high transmissivity react very slowly to droughts. Their supplies are virtually drought-proof even during long droughts. These aquifers, such as the Carrizo-Wilcox and Gulf Coast Aquifers, store enormous amounts of water. Somewhat thinner, yet still extensive, sand aquifers with low to moderate transmissivity commonly are only slightly less drought-resistant. These aquifers include the Trinity, Woodbine, Queen City, Sparta, and Hickory.

During long droughts, shallow alluvial aquifers from which large withdrawals are made experience water level declines that are relatively large in comparison to total saturated thickness. Supplies from these aquifers, such as the Seymour and Brazos River Alluvium Aquifers, can be affected by drought but generally only by extended droughts. In extended droughts, available well yields are typically reduced, and pumps must run longer for a given level of supply.

In thin aquifers with shallow supplies, drought resistance may not be adequate. Such aquifers in the BGRWPA include the Dockum, Blaine, and Edwards-Trinity (Plateau). Also, shallow supplies in or near outcrop areas of aquifers, even of major aquifers, may have limited drought resistance.

Aquifers composed of limestone and/or dolomite are commonly the least drought-resistant. This is because these aquifers typically have only about one-tenth as much storage per cubic foot as sand aquifers. For limestone aquifers, the amount of well development is also an important factor in drought resistance. Thus, the Edwards (BFZ) Aquifer, with more developed well capacity than is available in extended droughts, is the least drought-resistant of all the aquifers in the BGRWPA. Depending on location and exact local conditions, springflows and some Edwards (BFZ) well supplies are substantially reduced in only moderate droughts. In contrast, the Marble Falls and Ellenburger-San Saba Aquifers, which are relatively undeveloped by wells, can more slowly discharge a part of their stored water during long droughts.

In the Brazos G Region, for supplies drawing from the Edwards (BFZ) Aquifer, drought planning is critical. All of the other aquifers in the region are very drought resistant due to their inherent characteristics.

1.7.1.2 Surface Water

Surface water supplies in the region vary greatly, as rainfall ranges from 20 to 24 inches in Kent County in the northwest, to 40 to 44 inches in Grimes County in the southeast. Evaporation rates show a similarly wide variation, with the highest rates occurring in the northwestern part of the region.

Drought originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e., evaporation + transpiration). It is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness of the rains. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with drought in many regions of the world and can significantly aggravate its severity.

Hydrological drought is associated with the effects of periods of precipitation shortfalls on surface water supply. The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency affects the system water supply. Firm yields of reservoirs are estimated based on water that would be available through a repeat of the historic drought of record, which includes the effects of reduced runoff and high evaporation rates during the drought period. Water supply from run-of-the-river diversions are estimated based on water that would be available[16] through a repeat of the drought of record. The water supply estimates throughout this water plan are reliable through a repeat of the drought of record and are therefore not particularly susceptible to drought-induced shortages. However, the northwestern counties of the Brazos G region are currently suffering through a

[16] Estimates of municipal and industrial run-of-river diversions are for 100 percent reliability. For irrigation uses, run-of-river reliability is less than 100 percent reliable.

particularly dry spell and data shows that in some areas the 1997 through 2000 period has produced less runoff than the first three years of the drought of record in the 1950s. This situation is obviously being closely monitored by affected water supply entities and drought contingency plans may need to be implemented.

1.7.2 Identified Water Quality Problems

Water quality in the BGRWPA varies. Water quality is generally good in aquifers and in the tributaries of the Brazos River. However, high concentrations of chloride are found in the main stem of the Brazos River. Three factors affecting water quality in the Brazos G Region are wastewater disposal, high-density agricultural activities, and natural saline contamination.[17] Except for the third factor, these threats are associated with the growth of both population and the economy, and these are expected to continue growing in the future.

The 1997 *Water for Texas* plan identifies problems with water quality in the Brazos River Basin, and several of these problems occur in the BGRWPA. Citing the TNRCC's 1996 *Water Quality Inventory*, the *Plan* notes elevated levels of fecal coliform bacteria in several areas: the main stem of the Brazos River just downstream of the Navasota River, downstream of the Clear Fork of the Brazos, and near the cities of Marlin and Cameron. Tributaries of the Brazos River with elevated levels of fecal coliform are the Leon River downstream from Lake Proctor, Oyster Creek, and the North Bosque River and Upper North Bosque River. Also in the Bosque River, elevated levels of nutrients from several sources are contributing to excessive growth of plankton and attached algae. The TNRCC's Clean Rivers Program[18] has identified water quality concerns in the region with respect to levels of nutrients, turbidity, dissolved metals, algae, chlorophyll alpha, fecal coliform, ammonia, phosphorous, nitrogen, nitrate-nitrogen, total suspended solids, dissolved minerals, and dissolved oxygen. Natural salt loading is typical of the upper Brazos River in the Brazos G Region, and its effects have rendered much of the river and its three main-stem reservoirs (Possum Kingdom Lake, Lake Granbury, and Lake Whitney) unsuitable for drinking water supply without expensive demineralization treatment.[19]

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[17] Texas Natural Resource Conservation Commission (TNRCC), *Summary Report: Regional Assessments of Water Quality Pursuant to the Texas Clean Rivers Act (Senate Bill 818)*, 1992.
[18] TNRCC, *Summary Report: Regional Assessments of Water Quality Pursuant to the Texas Clean Rivers Act (Senate Bill 818)*, 1996.
[19] TNRCC, Op. Cit., 1992.

1.7.3 Identified Threats to Agricultural and Natural Resources

Drought is the primary threat to agricultural resources in the Brazos G Region. During long droughts, surface water supplies for unconfined livestock are diminished. If the drought extends through the season for growing forages, production is reduced due to the lack of rainfall. Additional threats to livestock arise from the reduced water supply for rural water systems that are not interconnected or that are not supplied by a reliable source. This is especially in the northwest part of the region. Water for confined livestock (e.g., dairy cattle and poultry) and for crop irrigation typically comes from groundwater. Threats to groundwater supplies were discussed in Section 1.3.1. An additional threat to crop production is the migration into agricultural land of municipal well fields near cities supplied by groundwater (e.g., Bryan and College Station). Groundwater Conservation Districts and Underground Water Conservation Districts have been created in part to address this issue. Section 1.8 contains additional information.

1.8 Drought Preparations

Drought contingency plans are required by the TWDB for wholesale water suppliers, irrigation districts, and retail water suppliers. To aid in the preparation of the water plans, the TNRCC, TWDB, Texas Water Utilities Association, and Texas Rural Water Association have sponsored workshops for those required to submit plans. The BRA was among the first to prepare and file a drought contingency plan in 1985, and the plan is routinely updated.

For surface water right-holders that supply 1,000 acft/yr or more for non-irrigation use and 10,000 acft/yr for irrigation use, SB1 requires a water conservation plan. Entities required to prepare and submit plans are identified in Table 1-8. The entities listed are those identified by the TNRCC as of April 1999.

In addition, conservation plans are commonly included in the management plans of Groundwater Water Conservation Districts or Underground Water Conservation Districts. Within the BGRWPA, five districts have been created: the Salt Fork Underground Water Conservation District in Kent County, the Saratoga Underground Water Conservation District in Lampasas County, the Lost Pines Underground Water Conservation District in Bastrop and Lee Counties, the Brazos Valley Underground Water Conservation District in Robertson and Brazos Counties, and the Clearwater Underground Water Conservation District in Bell County.

The Saratoga Underground Water Conservation District has filed a management plan, which the TWDB has certified. The plan addresses conservation measures but contains no specific initiatives for addressing droughts. The Clearwater Underground Water Conservation District was allowed to be created by the 71st Texas Legislature through an election in 1999. The Salt Fork Underground Water Conservation District has not filed a management plan with the TWDB. The Lost Pines and Brazos Valley entities were created by the 76th Legislature and are subject to future ratification or creation action by the 77th Legislature. No plans have been developed by either of these entities.

Table 1-8.
Entities Required to Submit
Water Conservation Plans[1]

Entity Name		
Acton MUD	City of Georgetown	Ebba Iron, Inc.
Aluminum Company of America	City of Graham	Franklin Federal Bancorp
Aquilla WSD	City of Granbury	
Bell County WCID No. 1	City of Groesbeck	Johnson County FWSD No. 1
Bistone MWSD	City of Harker Heights	Jonah Water Special Utility District
Bluebonnet Water Supply Corporation	City of Lampasas	Kempner Water Supply Corporation
Brazos Electric Cooperative	City of Lorena	Oryx Energy Company
Central Texas Water Supply Corporation	City of Marlin	Palo Pinto County Municipal Water District No. 1
Chisholm Trail Special Utility District	City of Robinson	Phillips Petroleum Company
City of Abilene	City of Rosebud	South Texas Water Company
City of Belton	City of Round Rock	Tex/Con Oil and Gas Company
City of Breckenridge	City of Stamford	Texaco, Inc.
City of Brenham	City of Stephenville	Texas Municipal Power Agency
City of Bryan	City of Strawn	TXU Electric
City of Cameron	City of Sweetwater	U.S. Department of the Army
City of Cedar Park	City of Taylor	Upper Leon River Municipal Water District
City of Cisco	City of Temple	West Central Texas Municipal Water District
City of Clyde	City of Waco	West Texas Utilities Company
City of Gatesville	Eastland County WSD	

[1] Information provided by TNRCC, April 1999.

1.9 Existing Programs and Goals

1.9.1 Texas Clean Rivers Act

In 1991, the 72nd Legislature passed the Texas Clean Rivers Act [20] to establish for the first time a watershed basis for water quality planning in Texas.[21,22] The Act requires each river basin in the State to be assessed for water quality and management strategies on an on-going basis. It also requires reports to be provided to the TNRCC every even-numbered year.[23] The Act provides specific guidelines for accomplishing the water quality assessments, including: (1) comprehensive assessments on a watershed basis with emphasis on non-point sources, nutrients, and toxic materials; (2) delegation of responsibility for assessments to river authorities; (3) formation of river basin steering committees; (4) discharge permitting on a basin-wide basis; and (5) assessment fees charged to wastewater- and water-rights permittees.

The BRA is a partner with the TNRCC in the Clean River Program for the BGRWPA. The program provides funding for BRA staff to assess water quality in the Brazos River Basin and to document local problems. Also, the program provides fee payers with site-specific information on water quality such as receiving water assessments and flow data. The 1996 *Report*[24] for the Brazos River Basin provides an assessment of water quality for the basin, drawing attention to: (1) the need for more long-term data on water quality, (2) a continued emphasis on the Basin Steering Committee for direction and comment on the water quality assessment program, (3) continued assistance in water quality monitoring from local partners in the Basin Monitoring Program, (4) emphasis on assessing and maintaining data, and (5) development of a geographical information system for the basin. The 1996 *Report* provides detailed findings about water quality and related items for selected sub-watersheds of the basin. The findings most relevant to the BGRWPA were summarized in Section 1.7.2.

1.9.2 Clean Water Act

The 1972 Federal Water Pollution Control Act, which as amended is called the Clean Water Act, is the federal law with the most impact on water quality protection in the BGRWPA.

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[20] Senate Bill 818, amending the Texas Water Code, Sections 5.103, 5.105, 26.011; T.A.C. Sections 320.1-320.9
[21] TNRCC, Op. Cit., 1992.
[22] TNRCC, Op. Cit., 1999.
[23] BRA, "Planning and Environmental Division", [Online] Available URL: http://www.brazos.org/home.htm, 1999.
[24] Brazos River Authority, 1999.

As amended in 1977 and again in 1987, the Clean Water Act: (1) establishes the framework for monitoring and controlling industrial and municipal point-source discharges through the National Pollutant Discharge Elimination System, (2) authorizes federal assistance for the construction of municipal wastewater treatment facilities, and (3) requires cities to obtain permits for stormwater or non-point-source discharges.[25] The Clean Water Act also includes provisions to protect specific aquatic resources. Section 303 establishes a non-degradation policy for high quality waters and provides for establishment of state standards for receiving water quality. Section 401 allows states to enforce water quality requirements for federal projects such as dams. Section 404 provides safeguards for wetlands and other waters from the discharge of dredged or fill material. Section 305 calls for the TNRCC to prepare and submits a water quality inventory to the U.S. Environmental Protection Agency.[26] Other provisions protect particular types of ecosystems such as lakes (Section 314), estuaries (Section 320), and oceans (Section 403).[27] Several of these provisions are relevant to specific water quality concerns in the BGRWPA.

1.9.3 Safe Drinking Water Act

The Safe Drinking Water Act, passed in 1974 and amended in 1986 and 1996, allows the U.S. Environmental Protection Agency to set standards for drinking water quality. These standards are divided into two categories: National Primary Drinking Water Regulations (primary standards that must be met by all public water suppliers) and National Secondary Water Regulations (secondary standards that are not enforceable, but are recommended). Primary standards protect water quality by limiting levels of contaminants that are known to adversely affect public health and that are anticipated to occur in water. Secondary standards have been set for contaminants that may affect cosmetic or aesthetic qualities of water (e.g., taste, odor, or color).

1.9.4 Water for Texas (1997)

Developed by the TWDB, *Water for Texas* is a comprehensive State plan that identifies current and prospective uses of water, water supplies and water users, necessary water-related

[25] 33 USCA, Sections 1251 through 1387.
[26] TWDB, 1997.
[27] Adler, R.W., Landman, J. and Cameron, D., *The Clean Water Act: Twenty Years Later*, Island Press, Washington D.C., 1993.

management measures, and facility needs and costs. The plan also recommends ways to better manage the State's water resources through the year 2050. Key management areas include:

- Water conservation
- Water reuse
- Expanded use of existing supplies
- Reallocation of reservoir storage
- Water marketing
- Subordination of water rights
- Yield enhancement measures
- Chloride control measures
- Interbasin transfers
- Development of new supplies

This plan offered several recommendations for the BGRWPA to aid the area in meeting future demand. Key recommendations include:

- Chloride control projects need to be constructed in the upper Brazos River Basin (Kiowa Peak, Dove, and Croton Brine Lakes) to reduce the salinity of downstream water supplies.
- Depletion of the Trinity Aquifer may require some entities to convert to surface water supplies.
- The City of Abilene will need to construct a pipeline to O.H. Ivie Reservoir to meet its projected needs in 2025.
- The Cities of Hamlin and Stamford may need to obtain water from either the West Central Texas Municipal Water District or the City of Abilene because sedimentation has severely reduced supply in Lake Stamford. Treatment facilities will need improvements in order to handle greater volumes of raw water.
- The Cities of Round Rock and Georgetown should consider participating in the construction of a pipeline from Lake Stillhouse Hollow to Lake Georgetown and possibly in the construction of the Lake Belton pipeline.
- The City of College Station should upgrade infrastructure to meet demand projected for year 2030.
- Paluxy Reservoir should be built by 2010 to meet the needs of the Cities of Glen Rose and Stephenville. At present, both cities fully depend on groundwater.
- The City of Cisco should consider contracting with the City of Abilene for water to supplement its current source, Lake Cisco. Current demands exceed Lake Cisco's dependable yield.
- Storage in Lake Whitney will need to be reallocated to consumptive use to meet projected demands in the BRA system.

The plan described above was adopted by the TWDB in August 1997, and it will be updated as prescribed by SB1 according to findings of this report. Since the completion of the 1997 plan, the following issues have arisen:

- It has been found that at this time, construction of the Paluxy Reservoir is not a viable option for meeting water needs in the region.
- The City of Stamford is pursuing obtaining water from Abilene as well as the possibility of diverting flow from California Creek to supplement its supply.
- The City of College Station has done studies to determine where upgrades are most needed and has begun upgrading its infrastructure.
- The Cities of Round Rock and Georgetown and the Jonah Special Utility District are constructing a raw-water pipeline from Lake Stillhouse Hollow to Lake Georgetown.

Section 2
Current and Projected Population and Water Demand Data for the Region

2.1 Introduction

In July 1998, the TWDB published population and water demand projections[1] for each county in the state. Population projections were developed for 134 cities and Census-Designated Place names (CDP) with a population greater than 500. To account for people living outside the cities, projections were also developed for a 'county-other' category for each county. Water demand projections were developed by type of use—municipal for cities (along with a 'county-other' for each county) and countywide for manufacturing, steam-electric, mining, irrigation, and livestock.

At their October 20, 1999 meeting, the TWDB adopted revised population and water demand projections for the BGRWPA, as forwarded by the Brazos G RWPG. Revisions had been made to the consensus-based population projections, and municipal, manufacturing, mining, and steam-electric water demand projections. Revisions to the population and municipal water demand projections for cities resulted from supported requests from individual cities. In addition, the BGRWPG has accepted population and water demand projections prepared by HDR Engineering, Inc. for 328 community water systems that serve areas outside cities. This work resulted in revised population and municipal water demand projections for the 'county-other' category. Finally, water demand projections for manufacturing, mining, and steam-electric categories were revised with input from representatives of these industries.

2.2 Population Projections

As shown in Figure 2-1, the population of the 37-county region is projected to increase from 1,671,446 in 2000 to 3,095,273 in 2050, an increase of 85.2 percent (1.24 percent annual growth). This compares to projected statewide population growth during the same period of 81.3 percent, (1.20 percent annually). In 2050, it is projected that 24 percent of the Brazos G Region population will live in Williamson County, 13 percent in Bell County, 11 percent in

[1] The population and water demand projections were developed in consultation with the Texas Parks and Wildlife Department and Texas Natural Resources Conservation Commission. The completed projections are referred to as the 1997 Consensus Population and Water Demand Projections.

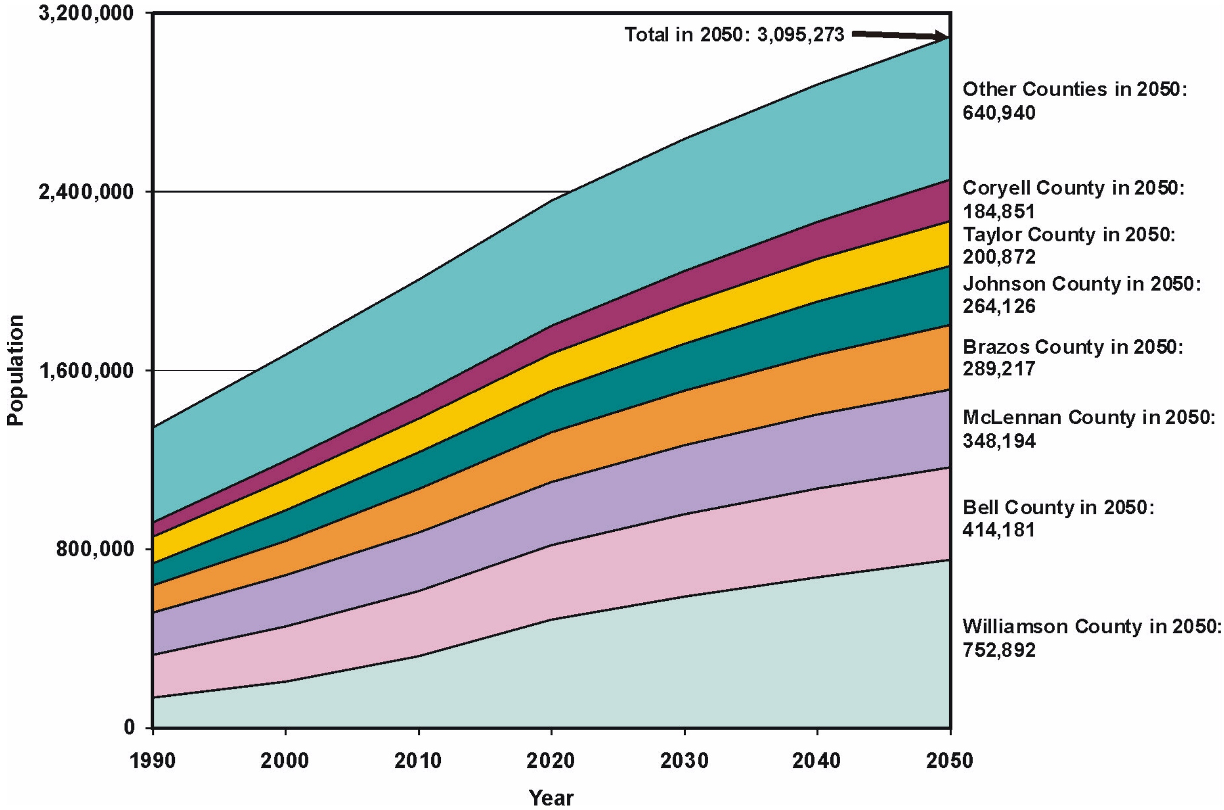

Figure 2-1. Population Projections

McLennan County, 9 percent in Brazos County, 8 percent in Johnson County, 7 percent in Taylor County, 6 percent in Coryell County, and less than 6 percent in each of the remaining counties. Projections and growth rates for each of the 37 counties and 133 cities in the region are presented in Table 2 1.

Growth is concentrated along the I-35 corridor, stretching from Williamson County in the south to Johnson County in the north. Growth is also taking place along US Highway 183 in Williamson and Lampasas Counties, Taylor and Jones Counties (Abilene area), and Brazos County (Bryan/College Station area). Williamson County is projected to be the fastest growing county in the next 50 years at 2.61 percent annually. Bell, Brazos, Coryell, Hood, Johnson, Lampasas, and Somervell Counties are all projected to grow at more than 1.0 percent annually. A comparison of the growth rates for all the counties is shown in Figure 2-2.

Table 2-1.
Historical and Projected Population by City/County

City/County	Historical[1]		Projections[2]						Percent Growth[3]	Percent Growth[3]
	1990	1996	2000	2010	2020	2030	2040	2050	1980-96	2000-50
Bell County										
Bartlett (P)	621	684	883	1,059	1,227	1,377	1,496	1,573	-0.11%	1.16%
Belton	12,476	13,826	16,789	20,088	23,236	26,008	28,188	29,593	1.64%	1.14%
Fort Hood (P)	17,021	18,528	17,021	17,021	17,021	17,021	17,021	17,021	0.17%	0.00%
Harker Heights	12,841	16,745	18,683	22,404	25,972	29,134	31,644	33,294	5.29%	1.16%
Holland	1,118	1,316	1,447	1,694	1,916	2,096	2,220	2,277	N/A	0.91%
Killeen	63,535	80,962	88,787	105,924	122,164	136,343	147,347	154,249	3.56%	1.11%
Little River-Academy	1,390	1,650	1,623	1,897	2,144	2,343	2,478	2,538	2.25%	0.90%
Morgans Point Resort	1,766	2,293	2,556	3,097	3,628	4,112	4,511	4,792	4.81%	1.26%
Nolanville	1,834	2,461	2,408	2,878	3,324	3,716	4,023	4,218	4.03%	1.13%
Rogers	1,131	1,211	1,279	1,513	1,730	1,913	2,049	2,126	-0.16%	1.02%
Salado (CDP)	N/A	1,382	1,601	1,996	2,402	2,792	3,137	3,409	N/A	1.52%
Temple	46,109	50,097	58,447	69,800	80,584	90,029	97,394	102,060	1.04%	1.12%
Troy	1,395	1,697	1,676	1,982	2,266	2,507	2,686	2,787	1.43%	1.02%
County-Other	29,851	29,294	34,150	40,379	45,668	49,649	52,160	54,244	0.69%	0.93%
Bell County Total	191,088	222,146	247,350	291,732	333,282	369,040	396,354	414,181	2.16%	1.04%
Bosque County										
Clifton	3,195	3,621	3,557	3,961	4,268	4,599	4,956	5,340	1.05%	0.82%
Meridian	1,390	1,459	1,520	1,662	1,818	1,989	2,175	2,379	0.58%	0.90%
Valley Mills (P)	1,085	1,153	1,090	1,107	1,118	1,149	1,202	1,257	-0.38%	0.29%
Walnut Springs	N/A	822	804	819	819	819	851	893	N/A	0.21%
County-Other	9,455	9,540	16,321	17,186	17,652	17,894	18,017	18,907	1.28%	0.29%
Bosque County Total	15,125	16,595	23,292	24,735	25,675	26,450	27,201	28,776	1.35%	0.42%
Brazos County										
Bryan	55,002	61,715	64,400	76,382	89,027	97,719	108,926	119,709	2.09%	1.25%
College Station	52,456	62,644	71,322	96,974	106,063	116,005	126,879	138,771	3.30%	1.34%
County-Other	14,404	13,734	16,841	21,376	27,257	30,956	30,801	30,737	0.86%	1.21%
Brazos County Total	121,862	138,093	152,563	194,732	222,347	244,680	266,606	289,217	2.46%	1.29%
Burleson County										
Caldwell	3,181	3,788	3,609	3,901	4,180	4,402	4,562	4,728	1.57%	0.54%
Somerville	1,542	1,653	1,596	1,835	1,991	2,316	2,311	2,306	-0.58%	0.74%
County-Other	8,902	9,695	9,709	10,353	11,039	11,389	11,881	13,022	1.58%	0.59%
Burleson County Total	13,625	15,136	14,914	16,089	17,210	18,107	18,754	20,056	1.30%	0.59%
Callahan County										
Baird	1,658	1,819	1,706	1,759	1,748	1,710	1,601	1,566	0.44%	-0.17%
Clyde	3,002	3,143	3,146	3,190	3,284	3,296	3,148	3,007	1.29%	-0.09%
Cross Plains	1,063	1,049	1,074	1,035	970	900	816	740	-1.04%	-0.74%
County-Other	6,136	6,431	5,934	6,246	6,152	5,983	5,565	5,574	0.99%	-0.13%
Callahan County Total	11,859	12,442	11,860	12,230	12,154	11,889	11,130	10,887	0.78%	-0.17%
Comanche County										
Comanche	4,087	4,464	4,107	4,146	4,234	4,346	4,451	4,577	0.57%	0.22%
DeLeon	2,190	2,338	2,195	2,215	2,263	2,323	2,379	2,446	-0.36%	0.22%
County-Other	7,104	7,270	6,886	6,951	7,099	7,288	7,463	7,674	1.14%	0.22%
Comanche County Total	13,381	14,072	13,188	13,312	13,596	13,957	14,293	14,697	0.68%	0.22%

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Table 2-1 (continued)

City/County	Historical[1]		Projections[2]						Percent Growth[3] 1980-96	Percent Growth[3] 2000-50
	1990	1996	2000	2010	2020	2030	2040	2050		
Coryell County										
Copperas Cove	24,079	29,123	33,900	45,328	58,004	71,505	85,395	99,271	2.55%	2.17%
Fort Gates	N/A	854	923	952	964	976	980	1,011	N/A	0.18%
Fort Hood (P)	18,559	19,817	18,559	18,559	18,559	18,559	18,559	18,559	2.57%	0.00%
Gatesville	11,492	12,245	15,638	22,423	30,958	39,289	44,005	49,287	4.28%	2.32%
County-Other	10,083	12,080	14,478	15,561	16,161	16,478	16,640	16,723	-2.41%	0.29%
Coryell County Total	64,213	74,119	83,498	102,823	124,646	146,807	165,579	184,851	1.68%	1.60%
Eastland County										
Cisco	3,813	4,162	3,802	3,718	3,657	3,509	3,347	3,169	-0.51%	-0.36%
Eastland	3,690	3,795	3,593	3,516	3,467	3,332	3,183	3,041	0.08%	-0.33%
Gorman	1,290	1,425	1,287	1,259	1,238	1,188	1,133	1,073	0.78%	-0.36%
Ranger	2,803	2,902	2,800	2,736	2,675	2,557	2,430	2,309	-0.50%	-0.38%
Rising Star	859	896	862	837	799	752	702	655	-1.83%	-0.55%
County-Other	6,033	6,318	5,596	5,480	5,420	5,219	4,997	4,705	0.74%	-0.35%
Eastland County Total	18,488	19,498	17,940	17,546	17,256	16,557	15,792	14,952	0.01%	-0.36%
Erath County										
Dublin	3,190	3,600	3,241	3,450	3,517	3,500	3,481	3,462	1.76%	0.13%
Stephenville	13,502	15,456	16,060	18,638	21,103	23,311	25,120	26,143	1.66%	0.98%
County-Other	11,299	11,713	13,527	16,202	17,439	18,254	18,761	19,267	2.45%	0.71%
Erath County Total	27,991	30,769	32,828	38,290	42,059	45,065	47,362	48,872	1.96%	0.80%
Falls County										
Lott	N/A	861	866	877	871	847	807	772	N/A	-0.23%
Marlin	6,386	6,587	6,947	7,367	7,774	8,225	8,684	9,169	-0.47%	0.56%
Rosebud	1,638	1,589	1,826	1,977	2,102	2,224	2,345	2,473	-1.66%	0.61%
County-Other	9,688	9,419	9,375	9,691	10,216	10,867	11,552	12,230	0.45%	0.53%
Falls County Total	17,712	18,456	19,014	19,912	20,963	22,163	23,388	24,644	0.18%	0.52%
Fisher County										
Roby	616	569	630	618	621	601	580	560	-2.21%	-0.24%
Rotan	1,913	1,774	1,909	1,842	1,811	1,720	1,646	1,575	-1.57%	-0.38%
County-Other	2,313	2,173	2,303	2,224	2,185	2,076	1,987	1,985	-1.56%	-0.30%
Fisher County Total	4,842	4,516	4,842	4,684	4,617	4,397	4,213	4,120	-1.65%	-0.32%
Grimes County										
Anderson	320	374	469	511	547	577	556	536	0.07%	0.27%
Navasota	6,296	6,973	6,763	7,436	8,022	8,527	8,683	9,260	0.97%	0.63%
County-Other	12,212	14,374	14,313	16,587	18,733	20,710	20,420	23,394	4.38%	0.99%
Grimes County Total	18,828	21,721	21,545	24,534	27,302	29,814	29,659	33,190	2.98%	0.87%
Hamilton County										
Hamilton	2,937	2,983	2,766	2,730	2,710	2,327	2,209	2,052	-0.42%	-0.60%
Hico	1,342	1,498	1,312	1,295	1,285	1,104	1,048	973	0.54%	-0.60%
County-Other	3,454	3,737	3,264	3,222	3,198	2,746	2,607	2,422	0.01%	-0.59%
Hamilton County Total	7,733	8,218	7,342	7,247	7,193	6,177	5,864	5,447	-0.06%	-0.60%
Haskell County										
Haskell	3,362	3,151	3,478	3,590	3,731	3,852	3,975	4,102	-1.13%	0.33%
Rule	783	725	843	844	853	874	895	917	-2.08%	0.17%
Stamford (P)	36	40	39	41	43	44	46	48	-0.73%	0.42%
County-Other	2,639	2,547	2,376	2,406	2,460	2,527	2,598	2,702	-0.77%	0.26%
Haskell County	6,820	6,463	6,736	6,881	7,087	7,297	7,514	7,769	-1.11%	0.29%

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Table 2-1 (continued)

City/County	Historical[1]		Projections[2]						Percent Growth[3]	Percent Growth[3]
	1990	1996	2000	2010	2020	2030	2040	2050	1980-96	2000-50
Hill County										
Hillsboro	7,072	7,722	7,234	7,479	7,822	8,209	8,596	9,009	0.27%	0.44%
Hubbard	1,589	1,667	1,604	1,658	1,734	1,820	1,906	1,998	-0.03%	0.44%
Itasca	1,523	1,617	1,545	1,598	1,671	1,754	1,836	1,924	0.07%	0.44%
Whitney	1,626	1,681	1,673	1,717	1,748	1,803	1,878	1,956	0.19%	0.31%
County-Other	15,336	16,851	17,168	18,451	19,253	19,677	19,895	20,005	1.77%	0.31%
Hill County Total	27,146	29,538	29,224	30,903	32,228	33,263	34,111	34,892	1.04%	0.36%
Hood County										
Granbury	4,045	5,195	8,281	14,808	23,618	26,296	29,278	32,599	2.81%	2.78%
Tolar	N/A	577	532	515	489	464	458	458	N/A	-0.30%
County-Other	24,936	27,341	32,802	38,181	43,552	51,269	56,207	58,926	4.10%	1.18%
Hood County Total	28,981	33,113	41,615	53,504	67,659	78,029	85,943	91,983	3.99%	1.60%
Johnson County										
Alvarado	2,918	3,293	3,266	4,039	4,851	5,718	6,348	7,047	1.25%	1.55%
Briar Oaks	N/A	620	565	565	578	584	615	636	N/A	0.24%
Burleson (P)	14,153	16,228	19,083	24,039	29,079	34,307	38,752	43,773	2.69%	1.67%
Cleburne	22,205	23,593	26,147	30,788	36,253	42,688	50,265	59,188	1.29%	1.65%
Godley	N/A	612	584	593	609	621	634	648	N/A	0.21%
Grand View	1,245	1,315	1,511	1,650	1,805	1,958	2,129	2,315	0.55%	0.86%
Joshua	3,828	4,380	4,761	6,474	8,189	9,981	11,431	13,092	7.06%	2.04%
Keene	3,944	4,467	5,582	6,804	8,294	9,559	11,018	12,699	2.49%	1.66%
Mansfield (P)	617	635	852	954	1,247	1,371	1,709	2,130	23.39%	1.85%
Rio Vista	N/A	664	611	625	627	629	657	692	N/A	0.25%
Venus (P)	979	1,192	795	887	999	1,090	1,227	1,363	N/A	1.08%
County-Other	47,276	52,464	73,879	85,904	92,791	102,626	113,363	120,543	3.88%	0.98%
Johnson County Total	97,165	109,463	137,636	163,322	185,322	209,132	238,148	264,126	3.05%	1.31%
Jones County										
Abilene (P)	797	3,484	884	1,325	1,463	1,577	1,699	1,786	12.86%	1.42%
Anson	2,644	2,677	2,772	2,940	3,084	3,236	3,378	3,526	-0.35%	0.48%
Hamlin	2,788	2,537	2,914	3,099	3,260	3,428	3,588	3,755	-1.53%	0.51%
Hawley	N/A	637	582	547	503	463	444	431	N/A	-0.60%
Stamford (P)	3,781	3,370	4,020	4,282	4,509	4,746	4,974	5,213	-1.79%	0.52%
County-Other	6,480	5,717	6,220	6,598	6,969	7,192	7,344	7,409	-0.49%	0.35%
Jones County Total	16,490	18,422	17,392	18,791	19,788	20,642	21,427	22,120	0.41%	0.48%
Kent County										
Jayton	608	564	589	587	545	493	442	382	-0.77%	-0.86%
County-Other	402	375	390	389	361	326	293	253	-1.87%	-0.86%
Kent County Total	1,010	939	979	976	906	819	735	635	-1.23%	-0.86%
Knox County										
Benjamin	225	235	234	245	255	263	268	274	-0.56%	0.32%
Knox City	1,440	1,433	1,507	1,577	1,640	1,694	1,728	1,763	-0.47%	0.31%
Munday	1,600	1,523	1,609	1,684	1,751	1,808	1,843	1,880	-0.82%	0.31%
County-Other	1,572	1,517	1,555	1,628	1,693	1,747	1,778	1,814	-1.02%	0.31%
Knox County Total	4,837	4,708	4,905	5,134	5,339	5,512	5,617	5,731	-0.77%	0.31%
Lampasas County										
Lampasas	6,382	7,709	7,647	8,367	10,001	11,954	14,289	17,080	1.41%	1.62%
Lometa	N/A	756	723	749	761	774	817	857	N/A	0.34%
County-Other	7,139	8,242	8,415	9,831	11,040	11,752	12,451	13,601	2.18%	0.96%
Lampasas County	13,521	16,707	16,785	18,947	21,802	24,480	27,557	31,538	2.09%	1.27%

Table 2-1 (continued)

City/County	Historical[1] 1990	Historical[1] 1996	Projections[2] 2000	2010	2020	2030	2040	2050	Percent Growth[3] 1980-96	Percent Growth[3] 2000-50
Lee County										
Giddings	4,093	4,523	4,476	4,936	5,379	5,746	6,146	6,591	0.85%	0.78%
Lexington	953	1,067	1,052	1,160	1,264	1,351	1,445	1,549	0.01%	0.78%
County-Other	7,808	8,599	8,605	9,798	10,533	11,047	11,817	12,672	2.34%	0.78%
Lee County Total	12,854	14,189	14,133	15,894	17,176	18,144	19,408	20,812	1.63%	0.78%
Limestone County										
Coolidge	N/A	748	690	662	645	636	614	608	N/A	-0.25%
Groesbeck	3,185	3,614	3,740	4,340	4,794	5,296	5,707	6,149	0.43%	1.00%
Kosse	N/A	548	489	467	436	414	409	406	N/A	-0.37%
Mexia	6,933	6,835	7,410	7,561	8,042	8,462	8,866	9,289	-0.23%	0.45%
Thornton	N/A	596	606	618	624	629	632	674	N/A	0.21%
County-Other	10,828	8,956	9,606	10,328	10,829	11,405	11,884	12,322	-0.53%	0.50%
Limestone County Total	20,946	21,297	22,541	23,976	25,370	26,842	28,112	29,448	0.32%	0.54%
McLennan County										
Bellmead	8,336	8,464	10,047	10,867	11,006	11,592	12,090	12,609	0.70%	0.46%
Beverly Hills	2,048	2,149	2,387	2,676	2,852	3,031	3,183	3,343	0.20%	0.68%
Bruceville-Eddy	1,074	1,307	2,078	2,649	3,292	4,080	4,816	5,318	1.13%	1.90%
Crawford	N/A	686	667	653	632	532	492	453	N/A	-0.77%
Gholson	N/A	748	703	667	643	618	607	601	N/A	-0.31%
Hewitt	8,983	10,545	15,060	20,713	26,099	27,977	28,485	28,523	4.46%	1.29%
Lacy-Lakeview	3,617	4,326	4,330	4,950	5,379	5,770	6,111	6,472	2.87%	0.81%
Lorena	1,158	1,582	1,889	2,612	3,304	3,787	4,238	4,743	N/A	1.86%
Mart	2,004	2,022	2,323	2,592	2,751	2,917	3,057	3,191	-0.87%	0.64%
Mcgregor	4,683	4,837	5,228	5,670	5,845	6,106	6,311	6,523	0.43%	0.44%
Moody	1,329	1,379	1,396	1,457	1,976	2,048	2,083	2,119	-0.03%	0.84%
Northcrest	1,725	1,873	1,802	1,880	1,892	1,904	1,936	1,969	-0.23%	0.18%
Riesel	N/A	885	724	709	667	657	597	530	N/A	-0.62%
Robinson	7,111	7,986	8,183	9,086	9,595	10,149	10,613	11,098	1.73%	0.61%
Valley Mills (P)	10	0	12	12	11	11	11	11	-100.00%	-0.17%
Waco	103,590	109,225	119,455	135,407	143,723	161,819	180,403	192,621	0.47%	0.96%
West	2,515	2,783	2,611	2,659	2,612	2,565	2,553	2,541	0.71%	-0.05%
Woodway	8,695	9,316	11,313	13,161	14,335	15,397	16,325	17,209	1.72%	0.84%
County-Other	32,245	32,566	39,161	43,503	45,969	47,289	47,972	48,320	1.69%	0.42%
McLennan County Total	189,123	202,679	229,369	261,923	282,583	308,249	331,883	348,194	1.08%	0.84%
Milam County										
Cameron	5,580	5,909	5,963	6,117	6,260	6,416	6,569	6,726	0.20%	0.24%
Rockdale	5,235	5,594	6,382	6,967	7,474	7,992	8,488	9,015	-0.02%	0.69%
Thorndale	1,092	1,316	1,291	1,357	1,415	1,477	1,535	1,592	0.10%	0.42%
County-Other	11,039	11,737	11,777	12,715	13,260	13,560	13,715	13,793	0.94%	0.32%
Milam County Total	22,946	24,556	25,413	27,156	28,409	29,445	30,307	31,126	0.48%	0.41%
Nolan County										
Roscoe	1,446	1,408	1,523	1,619	1,687	1,699	1,697	1,695	-0.90%	0.21%
Sweetwater	11,967	11,874	12,219	12,644	12,929	12,772	12,532	12,297	-0.19%	0.01%
County-Other	3,181	3,511	3,413	3,529	3,608	3,563	3,494	3,313	0.04%	-0.06%
Nolan County Total	16,594	16,793	17,155	17,792	18,224	18,034	17,723	17,305	-0.21%	0.02%

Table 2-1 (continued)

City/County	Historical[1]		Projections[2]						Percent Growth[3]	Percent Growth[3]
	1990	1996	2000	2010	2020	2030	2040	2050	1980-96	2000-50
Palo Pinto County										
Graford	N/A	599	560	538	505	475	465	460	N/A	-0.39%
Mineral Wells (P)	14,388	14,586	15,334	16,012	16,725	17,545	18,119	18,712	0.10%	0.40%
Palo Pinto	350	410	449	450	455	467	478	489	-0.47%	0.17%
Strawn	N/A	708	624	586	572	541	512	498	N/A	-0.45%
County-Other	10,317	10,077	9,694	10,863	11,866	12,858	13,478	14,582	0.52%	0.82%
Palo Pinto County Total	25,055	26,380	26,661	28,449	30,123	31,886	33,052	34,741	0.58%	0.53%
Robertson County										
Bremond	1,110	1,156	1,380	1,549	1,719	1,855	1,993	2,141	0.75%	0.88%
Calvert	1,536	1,481	1,655	1,866	2,066	2,252	2,410	2,579	-0.97%	0.89%
Franklin	1,336	1,432	1,594	1,810	2,032	2,210	2,391	2,587	0.37%	0.97%
Hearne	5,132	5,079	5,850	6,594	7,305	7,963	8,619	9,329	-0.40%	0.94%
County-Other	6,397	6,207	6,152	6,395	6,617	6,732	6,791	6,820	1.20%	0.21%
Robertson County Total	15,511	15,355	16,631	18,214	19,739	21,012	22,204	23,456	0.29%	0.69%
Shackelford County										
Albany	1,962	2,008	2,043	2,143	2,800	2,850	2,900	3,000	-1.24%	0.77%
County-Other	1,354	1,405	1,544	1,494	1,464	1,446	1,434	1,426	-0.26%	-0.16%
Shackelford County Total	3,316	3,413	3,587	3,637	4,264	4,296	4,334	4,426	-0.85%	0.42%
Somervell County										
Glen Rose	1,949	2,212	2,335	2,721	3,107	3,493	3,879	4,265	0.40%	1.21%
County-Other	3,411	3,749	4,136	5,090	6,322	7,889	9,860	12,319	3.75%	2.21%
Somervell County Total	5,360	5,961	6,471	7,811	9,429	11,382	13,739	16,584	2.28%	1.90%
Stephens County										
Breckenridge	5,665	5,808	5,875	6,114	6,332	6,524	6,723	6,892	-1.09%	0.32%
County-Other	3,345	4,130	3,365	3,726	3,852	3,917	3,947	3,962	2.01%	0.33%
Stephens County Total	9,010	9,938	9,240	9,840	10,184	10,441	10,670	10,854	0.01%	0.32%
Stonewall County										
Aspermont	1,214	1,076	1,199	1,194	1,182	1,152	1,106	1,062	-1.44%	-0.24%
County-Other	799	809	818	827	804	766	717	663	-1.61%	-0.42%
Stonewall County Total	2,013	1,885	2,017	2,021	1,986	1,918	1,823	1,725	-1.51%	-0.31%
Taylor County										
Abilene (P)	105,857	112,990	119,048	131,155	144,876	156,116	168,228	176,831	0.91%	0.79%
Merkel	2,469	2,542	3,416	3,782	4,130	4,452	4,699	4,960	0.12%	0.75%
Potosi (CDP)	N/A	1,508	1,473	1,134	1,011	962	953	921	N/A	-0.93%
Tuscola	N/A	634	602	594	565	549	519	498	N/A	-0.38%
Tye	1,088	1,194	1,152	1,170	1,188	1,199	1,187	1,175	-0.96%	0.04%
County-Other	10,241	8,572	12,901	14,130	15,288	15,961	16,290	16,487	-0.46%	0.49%
Taylor County Total	119,655	127,440	138,592	151,965	167,058	179,239	191,876	200,872	0.87%	0.75%
Throckmorton County										
Throckmorton	1,036	1,026	1,028	1,025	1,002	961	916	873	-0.84%	-0.33%
County-Other	844	816	829	826	808	776	750	753	-0.46%	-0.19%
Throckmorton County Total	1,880	1,842	1,857	1,851	1,810	1,737	1,666	1,626	-0.68%	-0.27%
Washington County										
Brenham	11,952	13,564	13,603	14,863	15,847	16,195	15,760	15,337	1.34%	0.24%
County-Other	14,202	15,731	16,523	18,317	19,752	20,366	19,951	17,669	2.24%	0.13%
Washington County Total	26,154	29,295	30,126	33,180	35,599	36,561	35,711	33,006	1.81%	0.18%

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Table 2-1 (continued)

City/County	Historical[1]		Projections[2]						Percent Growth[3]	Percent Growth[3]
	1990	1996	2000	2010	2020	2030	2040	2050	1980-96	2000-50
Williamson County										
Bartlett (P)	818	995	840	873	947	973	1,035	1,101	0.84%	0.54%
Brushy Creek (CDP)	N/A	7,735	12,589	20,648	22,798	23,800	23,800	23,800	N/A	1.28%
Cedar Park	5,161	10,847	17,439	30,978	39,642	46,915	53,413	56,026	7.38%	2.36%
Florence	N/A	1,126	1,060	1,349	1,682	2,097	2,318	2,489	N/A	1.72%
Georgetown	14,842	21,445	33,357	54,419	77,409	100,432	128,994	163,777	5.24%	3.23%
Granger	1,190	1,521	1,574	2,021	2,548	3,091	3,540	3,947	1.31%	1.86%
Hutto	N/A	821	1,065	1,578	2,280	3,216	4,322	5,532	N/A	3.35%
Leander	3,398	5,738	9,381	15,557	20,214	26,478	32,333	39,195	6.24%	2.90%
Round Rock (P)	30,923	48,961	58,742	92,430	140,605	165,487	189,521	197,313	9.29%	2.45%
Taylor	11,472	14,130	16,025	22,028	30,886	35,597	41,021	48,996	1.80%	2.26%
Thrall	N/A	745	691	774	976	1,224	1,378	1,532	N/A	1.61%
County-Other	68,991	62,355	55,009	78,886	145,312	179,271	193,494	209,184	3.44%	2.71%
Williamson County Total	136,795	176,419	207,772	321,541	485,299	588,581	675,169	752,892	5.41%	2.61%
Young County										
Graham	8,986	8,857	8,949	8,942	8,868	8,794	8,720	8,558	-0.22%	-0.09%
Newcastle	N/A	548	529	541	566	589	611	633	N/A	0.36%
County-Other	5,621	5,027	4,955	5,173	5,746	6,066	6,238	6,331	-0.95%	0.49%
Young County Total	14,607	14,432	14,433	14,656	15,180	15,449	15,569	15,522	-0.25%	0.15%
Total For Region	1,344,536	1,507,008	1,671,446	2,006,230	2,360,864	2,637,493	2,880,493	3,095,273	1.84%	1.24%
Total For State	16,986,510	19,128,261	20,230,584	23,491,920	27,280,478	30,673,901	33,839,709	36,670,967	1.87%	1.20%

N/A Indicates specific information on city was unavailable. Population is accounted for in "County-Other."
(P) Indicates city is in more than one county.
(CDP) Census designated Place name.
1 Historical water use data from TWDB.
2 Projections from TWDB or approved revision.
3 Compound annual growth rate.

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2.3 Water Demand Projections

Water demand projections have been compiled for each type of consumptive water use; municipal, manufacturing, steam-electric, mining, irrigation, and livestock. (Note: Projections for non-consumptive water uses, such as navigation, hydroelectric generation, and recreation, are not presented.) As shown in Table 2-2, total water use for the region is projected to increase from 725,766 acft in 2000 to 1,034,262 acft in 2050, a 42.5 percent increase. The trend in total water use is shown in Figure 2-3. The six types of water use as percentages of total water use are shown for 2000 and 2050 in Figure 2-4. Municipal, manufacturing, and steam-electric water use as percentages of the total water use increase from 2000 to 2050, while mining, irrigation, and livestock water use decrease as percentages of the total. A water demand projection summary sheet for each county—broken down by type of use—is presented in Section 4. The Brazos G

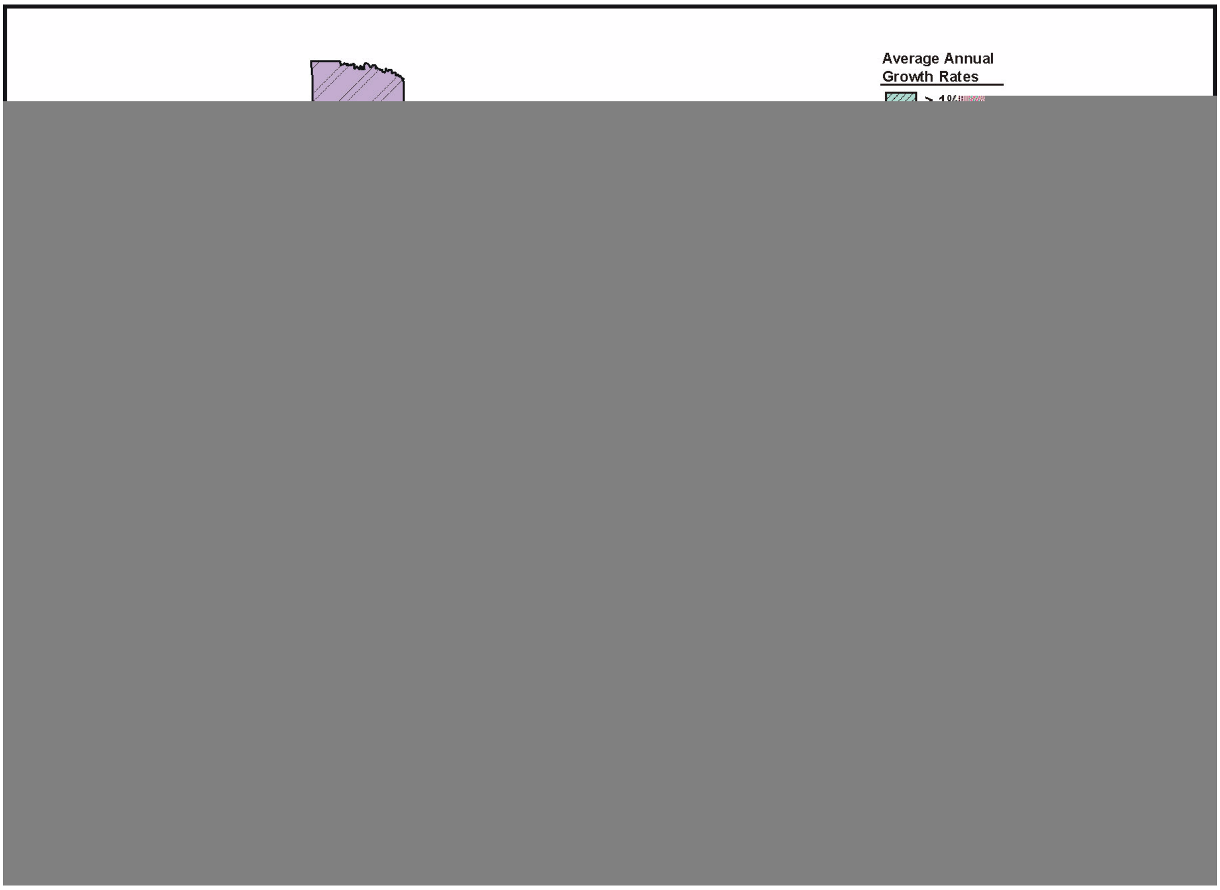

Figure 2-2. Brazos G Regional Water Planning Area Project County Growth Rates

Region includes parts of five river basins: the Brazos, Colorado, Red, Trinity, and San Jacinto. Total water demand for each basin is in shown in Table 2-2.

2.3.1 Municipal Water Demand

Water that is used by households (e.g., drinking, bathing, food preparation, dishwashing, laundry, flushing toilets, lawn watering and landscaping, swimming pools), commercial establishments, (e.g., restaurants, car washes, hotels, laundromats, and office buildings) and for fire protection, public recreation and sanitation are all referred to as municipal water. This type of water must meet safe-drinking water standards as specified by Federal and State laws and regulations.

Table 2-2.
Brazos G Regional Water Planning Area
Total Water Demand By Type of Use
(acft)

	Historical[1]		*Projections*[2]					
	1990	*1996*	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Water Use								
Municipal	236,955	273,457	310,376	357,407	405,936	445,751	479,189	509,592
Manufacturing	32,240	55,647	21,309	23,197	27,579	30,171	32,562	36,238
Steam Electric	57,657	69,118	103,020	156,076	174,324	179,324	189,324	202,824
Mining	6,944	17,387	40,107	48,749	53,339	53,300	53,470	53,903
Irrigation	200,954	198,687	197,188	193,125	189,468	185,547	181,736	177,939
Livestock	46,770	65,424	53,766	53,766	53,766	53,766	53,766	53,766
Total for Region	581,520	679,720	725,766	832,320	904,412	947,859	990,047	1,034,262
River Basin								
Brazos	561,097	654,881	700,277	805,886	877,538	919,310	960,072	1,002,812
Colorado	7,435	10,049	9,279	9,269	9,147	9,090	9,053	9,113
Red	221	281	276	274	274	274	273	274
Trinity	860	1,194	1,073	1,091	1,108	1,136	1,100	1,182
San Jacinto	11,907	13,315	14,861	15,800	16,345	18,049	19,549	20,881
Total for Region	581,520	679,720	725,766	832,320	904,412	947,859	990,047	1,034,262

[1] Historical water use data from TWDB.
[2] Projections from TWDB or approved revision.

Municipal water demand projections are computed by multiplying the projected population of an entity by the entity's projected per capita water use, adjusted for conservation savings. The projected per capita water use takes into account current plumbing, appliances, and other conservation technology. Per capita water use is projected to decline due to water conservation strategies—installation of water-efficient plumbing fixtures and landscaping, public education, and the effects of the 1991 State Water-Efficient Plumbing Act. Expected water conservation represents feasible strategies for economically sound water conservation savings.

Municipal water use for the region is projected to increase by 199,216 acft between 2000 and 2050, from 310,376 acft to 509,592 acft, a 64.2 percent rise. As can be seen in Figure 2-5, seven counties—Bell, Brazos, Coryell, Johnson, McLennan, Taylor, and Williamson—account for 82.1 percent of the total municipal water use in 2050. Municipal water use projections for all 37 counties and 133 cities are presented in Table 2-3.

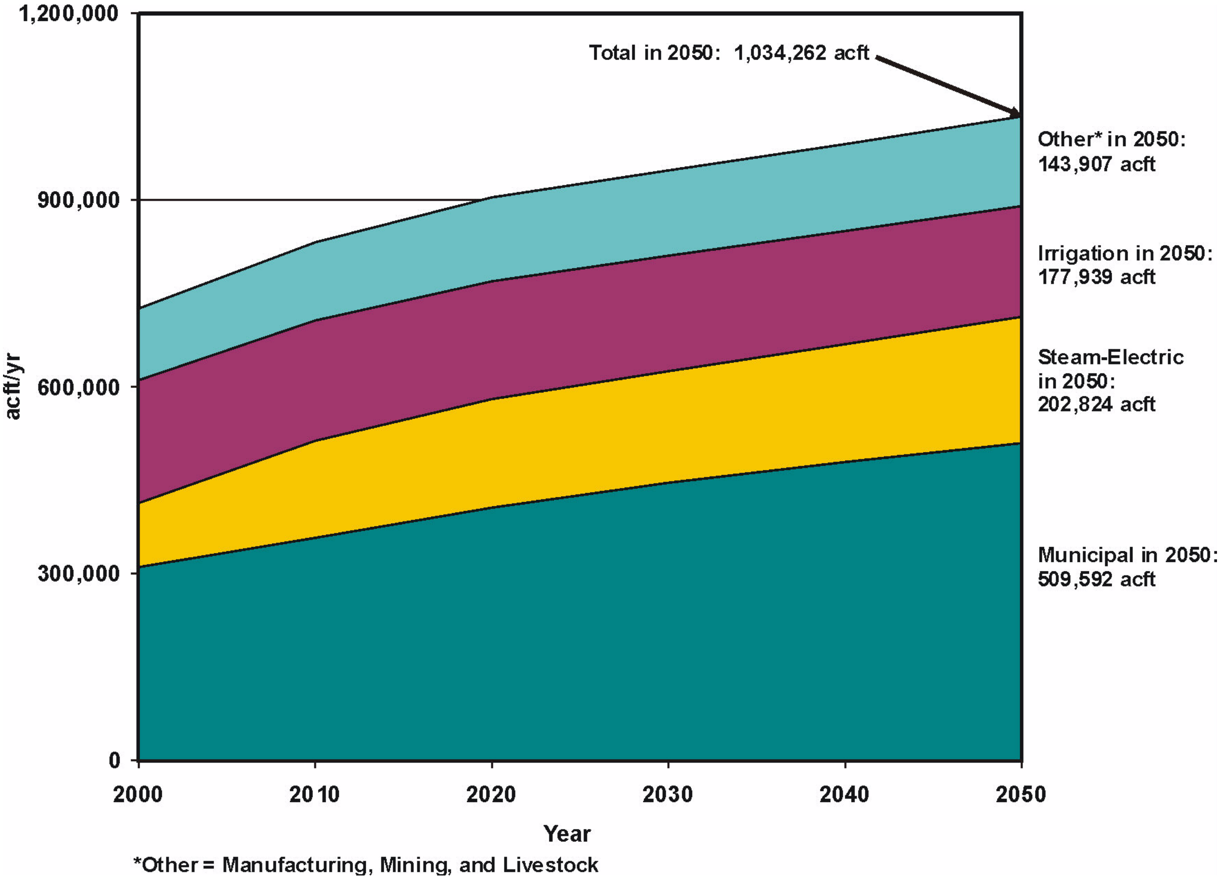

Figure 2-3. Projected Total Water Demand

The 64.2 percent projected increase in municipal water demand over the 50-year planning horizon is lower than the projected population increase of 85.2 percent due to expected savings in per capita water use resulting from water conservation.

2.3.2 Manufacturing Water Demand

Manufacturing is an integral part of the economy of the Brazos G Region, and for many industries water is key to the manufacturing process. It can be used in a variety of ways, including as a component of the final product, as a cooling agent during the manufacturing process, or for cleaning/wash-down of parts and/or products. In the Brazos G Region, industries that are major water users include food and kindred products, apparel, fabricated metal, machinery, and stone and concrete production.

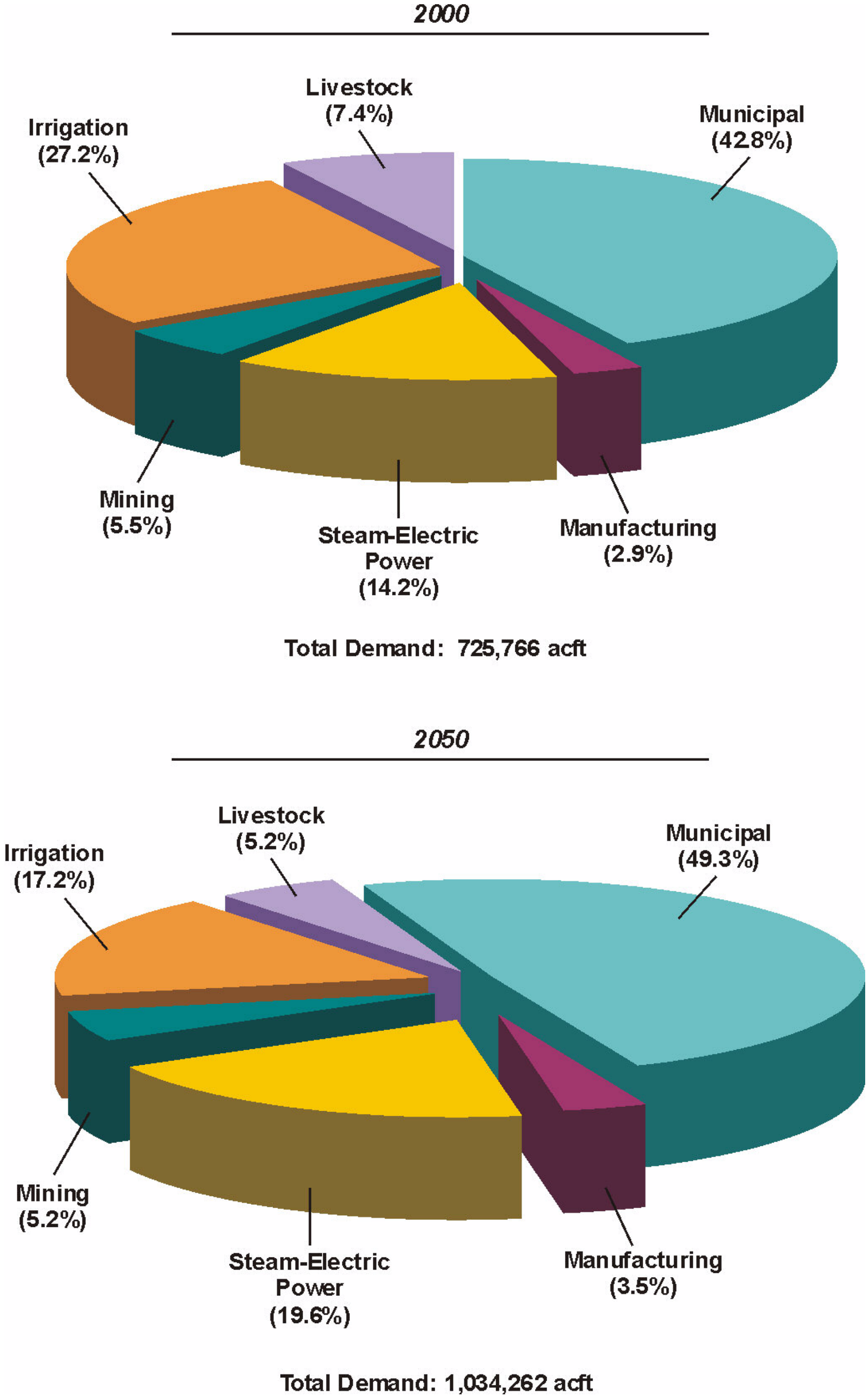

Figure 2-4. Total Water Demand by Type of Use in 2000 and 2050

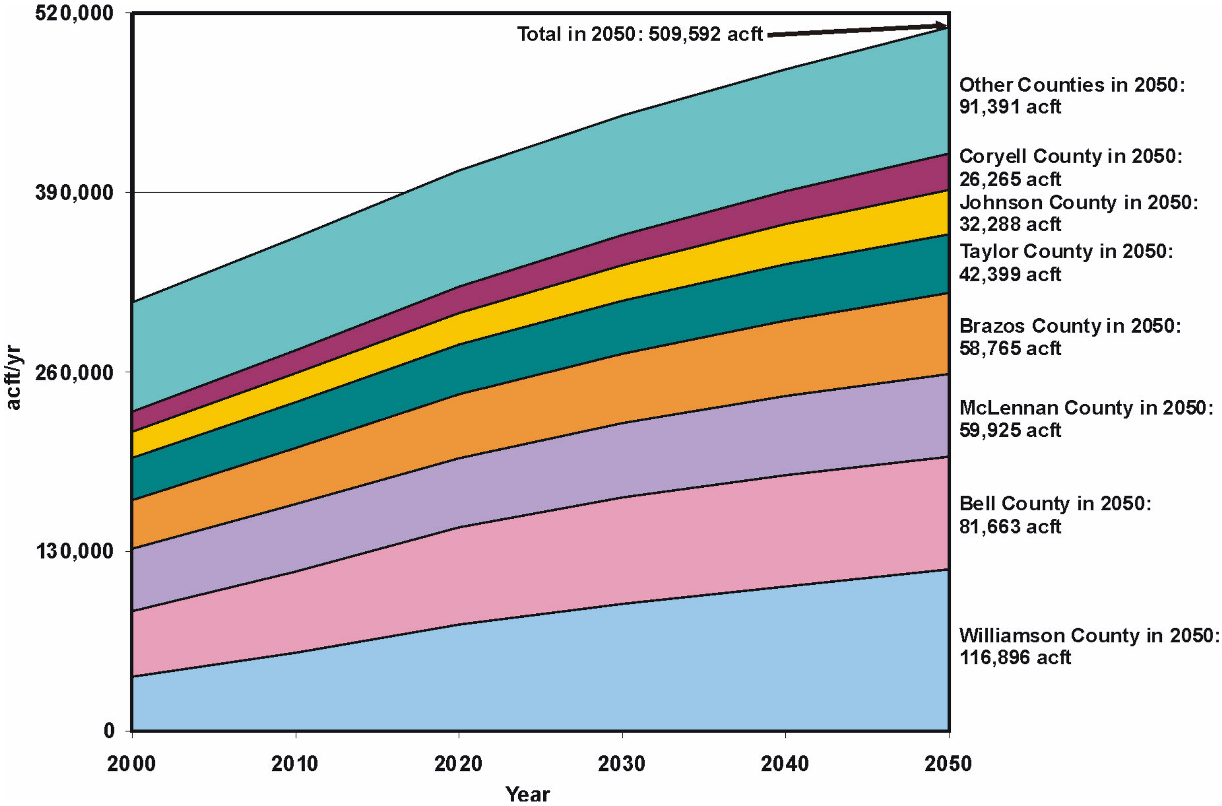

Figure 2-5. Municipal Water Demand Projections

Manufacturing water demand is projected by taking industry-specific water demand coefficients, adjusted for water-use efficiencies (recycling/reuse), and applying them to growth trends for each industry. These growth trends assume expansion of existing capacity and building of new facilities; continuation of historical trends of interaction between oil price changes and industrial activity; and that the makeup of each county's manufacturing base remains constant throughout the 50-year planning horizon.

Manufacturing use is projected to increase 70.1 percent, from 21,309 acft in 2000 to 36,238 acft in 2050 (Table 2-4). The trend in manufacturing use by county is shown in Figure 2-6. Bell, Johnson, McLennan, Milam, and Taylor Counties account for 80.2 percent of the total use in 2050. The projections for manufacturing use in Milam County were revised, accounting for the decrease from 1996 to 2000. The Aluminum Company of America (ALCOA), in Milam County, uses water for three separate processes: manufacturing, mining, and steam-electric. With input from the company's representatives it was determined that the

Table 2-3.
Historical and Projected Municipal Water Demand by City/County
(acft)

	Historical[1]		Projections[2]					
City/County	1990	1996	2000	2010	2020	2030	2040	2050
Bell County								
Bartlett (P)	128	159	173	219	261	293	310	308
Belton	2,194	2,205	2,727	3,713	4,685	5,390	5,683	5,801
Fort Hood (P)	3,227	3,616	4,766	4,766	4,766	4,766	4,766	4,766
Harker Heights	1,985	2,677	3,997	4,894	5,528	6,037	6,416	6,676
Holland	115	132	178	247	333	376	385	383
Killeen	7,953	10,212	11,935	18,391	24,631	27,185	28,884	28,509
Little River-Academy	222	246	255	340	444	486	500	483
Morgans Point Resort	264	274	429	607	772	875	935	939
Nolanville	233	284	297	419	577	666	698	709
Rogers	203	183	179	237	300	343	356	357
Salado (CDP)	N/A	812	755	910	1,057	1,220	1,356	1,470
Temple	10,492	12,175	13,094	16,419	19,407	21,178	21,819	21,721
Troy	167	248	235	311	393	449	466	468
County-Other	5,980	5,981	8,369	7,379	7,242	7,836	7,986	9,073
Bell County Total	33,163	39,204	47,389	58,852	70,396	77,100	80,560	81,663
Bosque County								
Clifton	495	588	625	674	717	773	832	897
Meridian	233	222	293	296	315	337	365	400
Valley Mills (P)	162	189	155	149	142	140	141	146
Walnut Springs	N/A	78	93	88	83	79	78	81
County-Other	1,324	1,334	2,010	1,978	1,966	1,935	1,919	2,093
Bosque County Total	2,214	2,411	3,176	3,185	3,223	3,264	3,335	3,617
Brazos County								
Bryan	9,440	9,436	12,042	13,433	14,859	15,984	17,448	19,179
College Station	14,351	16,621	20,653	24,435	28,085	30,647	33,974	36,561
County-Other	1,853	1,855	2,409	2,908	3,427	3,601	3,334	3,025
Brazos County Total	25,644	27,912	35,104	40,776	46,371	50,232	54,756	58,765
Burleson County								
Caldwell	627	705	768	791	810	838	853	879
Somerville	248	356	247	265	272	306	298	297
County-Other	993	1,215	1,181	1,188	1,213	1,213	1,246	1,342
Burleson County Total	1,868	2,276	2,196	2,244	2,295	2,357	2,397	2,518
Callahan County								
Baird	270	248	327	321	302	287	260	256
Clyde	439	439	448	429	416	402	367	350
Cross Plains	176	161	227	209	185	165	150	134
County-Other	694	875	698	694	655	616	568	568
Callahan County Total	1,579	1,723	1,700	1,653	1,558	1,470	1,345	1,308

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Table 2-3 (continued)

City/County	Historical[1] 1990	1996	Projections[2] 2000	2010	2020	2030	2040	2050
Comanche County								
Comanche	575	585	695	664	645	643	638	651
DeLeon	299	293	344	330	317	315	312	318
County-Other	899	893	863	828	796	785	774	786
Comanche County Total	1,773	1,771	1,902	1,822	1,758	1,743	1,724	1,755
Coryell County								
Copperas Cove	2,881	3,667	4,557	5,687	6,887	8,250	9,565	11,120
Fort Gates	N/A	163	167	164	159	156	153	156
Fort Hood (P)	3,519	3,867	4,511	4,303	4,116	4,033	3,950	3,929
Gatesville	1,715	2,329	3,311	4,471	5,895	7,394	8,232	9,165
County-Other	1,487	1,930	1,959	1,979	2,009	1,999	1,949	1,895
Coryell County Total	9,602	11,956	14,505	16,604	19,066	21,832	23,849	26,265
Eastland County								
Cisco	498	584	669	621	578	538	502	472
Eastland	845	762	1,159	1,087	1,029	970	920	875
Gorman	158	146	180	166	153	141	131	123
Ranger	359	406	643	601	560	521	487	460
Rising Star	78	88	97	87	77	68	62	57
County-Other	1,128	809	991	938	925	899	866	818
Eastland County Total	3,066	2,795	3,739	3,500	3,322	3,137	2,968	2,805
Erath County								
Dublin	428	385	472	471	453	435	417	411
Stephenville	2,397	2,404	3,238	3,570	3,877	4,178	4,390	4,539
County-Other	1,388	1,618	1,602	1,772	1,794	1,815	1,807	1,855
Erath County Total	4,213	4,407	5,312	5,813	6,124	6,428	6,614	6,805
Falls County								
Lott	N/A	N/A	108	102	96	89	81	77
Marlin	1,281	1,218	1,338	1,362	1,376	1,419	1,469	1,541
Rosebud	182	196	237	239	238	244	247	258
County-Other	1,250	986	1,177	1,144	1,154	1,195	1,240	1,288
Falls County Total	2,713	2,400	2,860	2,847	2,864	2,947	3,037	3,164
Fisher County								
Roby	54	92	68	63	59	54	49	48
Rotan	214	267	276	250	231	210	197	187
County-Other	457	469	508	475	461	433	414	413
Fisher County Total	725	828	852	788	751	697	660	648
Grimes County								
Anderson	56	58	78	81	82	85	80	76
Navasota	1,210	1,450	901	925	935	955	941	997
County-Other	1,508	2,199	1,799	1,917	2,050	2,197	2,107	2,368
Grimes County Total	2,774	3,707	2,778	2,923	3,067	3,237	3,128	3,441

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Table 2-3 (continued)

City/County	Historical[1] 1990	1996	Projections[2] 2000	2010	2020	2030	2040	2050
Hamilton County								
Hamilton	637	555	626	587	552	456	433	400
Hico	241	225	253	236	223	183	174	160
County-Other	471	495	422	392	364	294	280	259
Hamilton County Total	1,349	1,275	1,301	1,215	1,139	933	887	819
Haskell County								
Haskell	450	592	549	535	527	526	525	538
Rule	127	113	133	127	121	120	119	121
Stamford (P)	8	13	11	11	11	11	11	12
County-Other	240	265	303	321	324	325	330	337
Haskell County	825	983	996	994	983	982	985	1,008
Hill County								
Hillsboro	1,095	1,423	1,296	1,273	1,270	1,297	1,319	1,372
Hubbard	183	153	207	201	196	198	199	206
Itasca	165	151	223	217	213	217	220	228
Whitney	196	276	189	183	172	170	170	175
County-Other	2,014	2,704	2,255	2,273	2,281	2,270	2,264	2,247
Hill County Total	3,653	4,707	4,170	4,147	4,132	4,152	4,172	4,228
Hood County								
Granbury	851	1,050	1,389	2,487	3,965	4,367	4,810	5,297
Tolar	N/A	94	52	47	41	37	34	34
County-Other	2,974	3,233	3,506	3,855	4,307	4,953	5,397	5,650
Hood County Total	3,825	4,377	4,947	6,389	8,313	9,357	10,241	10,981
Johnson County								
Alvarado	310	392	426	515	627	692	762	840
Briar Oaks		81	71	67	64	62	63	64
Burleson (P)	1,760	2,171	2,287	2,639	2,671	3,113	3,473	3,874
Cleburne	3,421	4,200	5,301	5,932	6,660	7,698	8,896	10,409
Godley	N/A	96	95	91	89	88	87	88
Grand View	176	200	200	205	210	222	234	252
Joshua	347	708	416	500	578	671	743	851
Keene	457	532	773	941	1,154	1,299	1,462	1,645
Mansfield (P)	82	117	136	142	158	172	212	262
Rio Vista	N/A	66	65	62	58	55	55	57
Venus (P)	123	273	292	317	353	383	431	478
County-Other	5,595	6,757	8,817	9,559	10,079	11,476	12,675	13,468
Johnson County Total	12,271	15,593	18,879	20,970	22,719	25,931	29,093	32,288

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Table 2-3 (continued)

City/County	Historical[1] 1990	Historical[1] 1996	Projections[2] 2000	2010	2020	2030	2040	2050
Jones County								
Abilene (P)	193	205	206	306	338	360	384	400
Anson	424	514	497	497	491	504	511	529
Hamlin	640	397	685	691	694	714	735	766
Hawley	N/A	158	155	140	123	111	104	101
Stamford (P)	783	1,090	1,126	1,146	1,152	1,191	1,231	1,285
County-Other	686	647	620	610	604	598	608	611
Jones County Total	2,726	3,011	3,289	3,390	3,402	3,478	3,573	3,692
Kent County								
Jayton	139	144	157	149	131	115	103	89
County-Other	49	52	50	47	41	34	31	27
Kent County Total	188	196	207	196	172	149	134	116
Knox County								
Benjamin	95	58	105	106	106	108	109	111
Knox City	235	210	241	238	235	235	232	235
Munday	267	298	299	296	290	294	291	295
County-Other	216	250	263	260	256	256	253	256
Knox County Total	813	816	908	900	887	893	885	897
Lampasas County								
Lampasas	1,280	1,320	1,670	1,874	2,185	2,544	2,977	3,501
Lometa	N/A	105	126	123	118	117	120	125
County-Other	1,037	1,310	1,429	1,560	1,656	1,729	1,810	1,960
Lampasas County	2,317	2,735	3,225	3,557	3,959	4,390	4,907	5,586
Lee County								
Giddings	1,299	1,114	1,369	1,443	1,513	1,597	1,686	1,802
Lexington	226	247	238	249	259	271	285	304
County-Other	1,466	1,930	1,619	1,691	1,749	1,819	1,906	2,044
Lee County Total	2,991	3,291	3,226	3,383	3,521	3,687	3,877	4,150
Limestone County								
Coolidge	N/A	82	98	90	82	78	73	72
Groesbeck	612	612	721	807	854	908	959	1,026
Kosse	N/A	119	106	97	86	80	77	76
Mexia	989	1,174	1,054	1,016	1,017	1,033	1,053	1,093
Thornton	N/A	64	69	66	62	60	57	60
County-Other	1,372	1,074	1,434	1,448	1,443	1,460	1,476	1,510
Limestone County Total	2,973	3,125	3,482	3,524	3,544	3,619	3,695	3,837

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Table 2-3 (continued)

	Historical[1]		Projections[2]					
City/County	***1990***	***1996***	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
McLennan County								
Bellmead	1,170	1,307	1,317	1,339	1,282	1,311	1,327	1,370
Beverly Hills	453	442	553	591	601	628	649	678
Bruceville-Eddy	516	588	291	362	435	530	620	685
Crawford	na	79	128	119	110	90	81	74
Gholson	na	120	100	90	81	76	72	71
Hewitt	1,154	1,567	2,227	2,854	3,420	3,573	3,606	3,578
Lacy-Lakeview	334	541	495	527	530	549	561	587
Lorena	180	293	267	334	389	437	479	531
Mart	338	315	487	517	527	549	565	586
Mcgregor	904	836	1,089	1,124	1,106	1,129	1,145	1,176
Moody	181	197	188	184	230	232	231	233
Northcrest	159	200	208	202	191	183	180	179
Riesel	na	99	98	91	81	77	67	59
Robinson	919	993	1,146	1,191	1,182	1,216	1,236	1,280
Valley Mills (P)	2	0	2	2	1	1	1	1
Waco	22,931	22,474	27,698	29,880	30,427	33,533	36,778	39,053
West	526	388	524	506	474	454	440	433
Woodway	2,175	2,185	2,737	3,037	3,163	3,346	3,511	3,682
County-Other	5,270	5,587	5,832	5,891	5,875	5,957	5,819	5,669
McLennan County Total	37,212	38,211	45,387	48,841	50,105	53,871	57,368	59,925
Milam County								
Cameron	1,064	1,466	1,363	1,336	1,304	1,308	1,310	1,334
Rockdale	1,491	1,226	1,730	1,803	1,842	1,943	2,035	2,151
Thorndale	121	165	143	140	136	136	136	139
County-Other	1,375	1,735	1,796	1,834	1,850	1,851	1,848	1,836
Milam County Total	4,051	4,592	5,032	5,113	5,132	5,238	5,329	5,460
Nolan County								
Roscoe	236	231	280	281	278	272	266	264
Sweetwater	3,164	3,300	3,914	3,881	3,809	3,705	3,580	3,512
County-Other	602	600	715	707	687	667	638	601
Nolan County Total	4,002	4,131	4,909	4,869	4,774	4,644	4,484	4,377
Palo Pinto County								
Graford	N/A	74	74	67	59	54	51	49
Mineral Wells (P)	2,823	2,586	2,868	2,834	2,810	2,869	2,902	2,976
Palo Pinto	66	67	89	85	82	82	82	83
Strawn	N/A	137	99	89	82	75	69	66
County-Other	1,276	992	1,218	1,276	1,331	1,388	1,427	1,540
Palo Pinto County Total	4,165	3,856	4,348	4,351	4,364	4,468	4,531	4,714

Table 2-3 (continued)

City/County	Historical[1]		Projections[2]					
	1990	1996	2000	2010	2020	2030	2040	2050
Robertson County								
Bremond	133	148	161	168	175	181	190	201
Calvert	426	396	441	474	504	540	570	610
Franklin	173	291	245	260	273	290	308	330
Hearne	1,106	1,250	1,278	1,366	1,440	1,543	1,641	1,766
County-Other	772	835	811	764	712	692	693	691
Robertson County Total	2,610	2,920	2,936	3,032	3,104	3,246	3,402	3,598
Shackelford County								
Albany	582	544	553	526	492	447	407	370
County-Other	206	258	198	186	170	152	137	123
Shackelford County Total	788	802	751	712	662	599	544	493
Somervell County								
Glen Rose	358	384	473	546	616	685	752	817
County-Other	413	466	556	753	921	1,122	1,370	1,670
Somervell County Total	771	850	1,029	1,299	1,537	1,807	2,122	2,487
Stephens County								
Breckenridge	1,352	1,082	1,448	1,431	1,418	1,432	1,446	1,475
County-Other	470	484	535	495	449	411	386	365
Stephens County Total	1,822	1,566	1,983	1,926	1,867	1,843	1,832	1,840
Stonewall County								
Aspermont	260	289	246	233	220	208	193	187
County-Other	96	100	125	120	109	100	92	84
Stonewall County Total	356	389	371	353	329	308	285	271
Taylor County								
Abilene (P)	25,608	27,211	27,737	30,264	33,430	35,674	38,065	39,615
Merkel	309	394	597	623	648	678	705	739
Potosi (CDP)	N/A	213	201	146	121	111	107	101
Tuscola	N/A	70	98	92	82	77	71	67
Tye	144	178	143	136	130	126	120	117
County-Other	1,312	1,370	1,906	1,897	1,620	1,669	1,720	1,760
Taylor County Total	27,373	29,436	30,682	33,158	36,031	38,335	40,788	42,399
Throckmorton County								
Throckmorton	198	231	193	184	171	158	148	140
County-Other	91	91	98	92	83	76	70	70
Throckmorton County Total	289	322	291	276	254	234	218	210
Washington County								
Brenham	2,243	3,211	2,438	2,514	2,538	2,540	2,401	2,336
County-Other	1,781	2,001	2,021	2,086	2,140	2,142	2,054	1,816
Washington County Total	4,024	5,212	4,459	4,600	4,678	4,682	4,455	4,152

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Table 2-3 (continued)

City/County	*Historical[1]*		*Projections[2]*					
	1990	***1996***	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Williamson County								
Bartlett (P)	169	232	197	196	203	205	213	227
Brushy Creek (CDP)	N/A	1,895	2,538	3,955	4,214	4,345	4,239	4,212
Cedar Park	566	3,141	3,516	5,933	7,326	8,916	9,513	9,916
Florence	N/A	196	195	238	290	340	383	416
Georgetown	3,369	4,422	7,052	10,444	13,826	17,416	21,962	27,800
Granger	168	212	245	292	311	374	424	469
Hutto	N/A	113	131	194	281	396	532	681
Leander	574	876	1,891	2,979	3,736	4,832	5,759	6,934
Round Rock (P)	6,055	12,556	13,339	19,672	26,345	30,839	35,318	40,225
Taylor	2,038	2,183	3,016	3,874	5,155	5,861	6,663	7,958
Thrall	N/A	78	83	87	102	123	133	146
County-Other	10,813	11,220	7,024	8,675	15,221	18,319	19,414	17,912
Williamson County Total	23,752	37,124	39,227	56,539	77,010	91,966	104,553	116,896
Young County								
Graham	1,666	1,826	2,085	1,993	1,877	1,822	1,768	1,716
Newcastle	N/A	55	107	104	104	106	107	110
County-Other	809	666	636	569	542	567	581	588
Young County Total	2,475	2,547	2,828	2,666	2,523	2,495	2,456	2,414
Total For Region	236,955	273,457	310,376	357,407	405,936	445,751	479,189	509,592

(P) Indicates city is in more than one county.
(CDP) Census Designated Place name.
N/A Indicates specific information was unavailable. Population is accounted for in County-Other.
[1] Historical water use data from TWDB.
[2] Projections from TWDB or approved revision.

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1997 Consensus Water Plan manufacturing water demand projections reflected water use for mining and steam-electric uses as well as manufacturing. The revised projections for manufacturing water use reported in Table 2-4 for Milam County have been revised to show manufacturing use only.

2.3.3 Steam-Electric Water Demand

The projections for steam-electric water demand are based on power generation projections—determined by population and manufacturing growth—and on power generation capacity and fresh water use for that projected capacity. The steam-electric generation process uses water in boilers and for cooling. Grimes, Limestone, McLennan, Milam, Robertson, and Somervell Counties account for 76.0 percent of total steam-electric water use in 2050. By the year 2000 it is projected that 103,020 acft will be used, increasing to 202,824 acft by 2050, a

Table 2-4.
Historical and Projected Manufacturing Water Demand by County
(acft)

County	Historical[1]		Projections[2]					
	1990	1996	2000	2010	2020	2030	2040	2050
Bell	966	1,082	4,040	4,640	6,320	7,620	8,380	8,700
Bosque	766	640	857	947	1,040	1,137	1,236	1,336
Brazos	168	264	194	221	244	262	295	329
Burleson	117	142	131	145	158	171	182	194
Callahan	0	0	0	0	0	0	0	0
Comanche	23	16	28	32	38	43	50	58
Coryell	8	3	9	11	13	15	16	17
Eastland	15	37	16	17	18	18	19	21
Erath	86	163	95	103	109	113	129	141
Falls	0	6	0	0	0	0	0	0
Fisher	129	147	144	159	175	191	208	224
Grimes	248	361	280	314	351	391	435	483
Hamilton	0	3	0	0	0	0	0	0
Haskell	0	0	0	0	0	0	0	0
Hill	62	226	72	83	93	102	116	130
Hood	9	10	11	13	16	19	22	26
Johnson	948	931	1,134	1,338	1,563	1,803	2,064	2,333
Jones	306	519	331	353	369	380	409	436
Kent	0	0	0	0	0	0	0	0
Knox	0	0	0	0	0	0	0	0
Lampasas	106	118	114	121	127	131	141	151
Lee	5	4	6	7	8	9	11	12
Limestone	368	7	453	549	657	779	913	1,061
McLennan	2,698	2,460	3,106	3,553	3,985	4,419	4,967	5,652
Milam	22,047	45,124	6,820	6,820	8,250	8,250	8,250	9,800
Nolan	499	570	558	619	682	747	815	885
Palo Pinto	56	19	65	74	83	93	108	125
Robertson	34	34	42	51	61	72	84	98
Shackelford	0	0	0	0	0	0	0	0
Somervell	0	2	0	0	0	0	0	0
Stephens	7	7	7	7	7	8	8	8
Stonewall	0	0	0	0	0	0	0	0
Taylor	1,638	950	1,775	1,921	2,062	2,201	2,387	2,575
Throckmorton	0	0	0	0	0	0	0	0
Washington	470	551	495	519	538	569	616	663
Williamson[3]	326	1,220	368	398	409	405	443	481
Young	135	31	158	182	203	223	258	299
Total For Region	32,240	55,647	21,309	23,197	27,579	30,171	32,562	36,238

1 Historical water use data from TWDB.
2 Projections from TWDB or approved revision.
3 Projected manufacturing demand is reported from the 1997 Consensus Water Plan data and appears to be relatively low for the economic activity in the county. Previously, the Trans-Texas Water Plan had projected 23,700 acft of manufacturing demand in 2050. This additional water demand will be planned for accordingly.

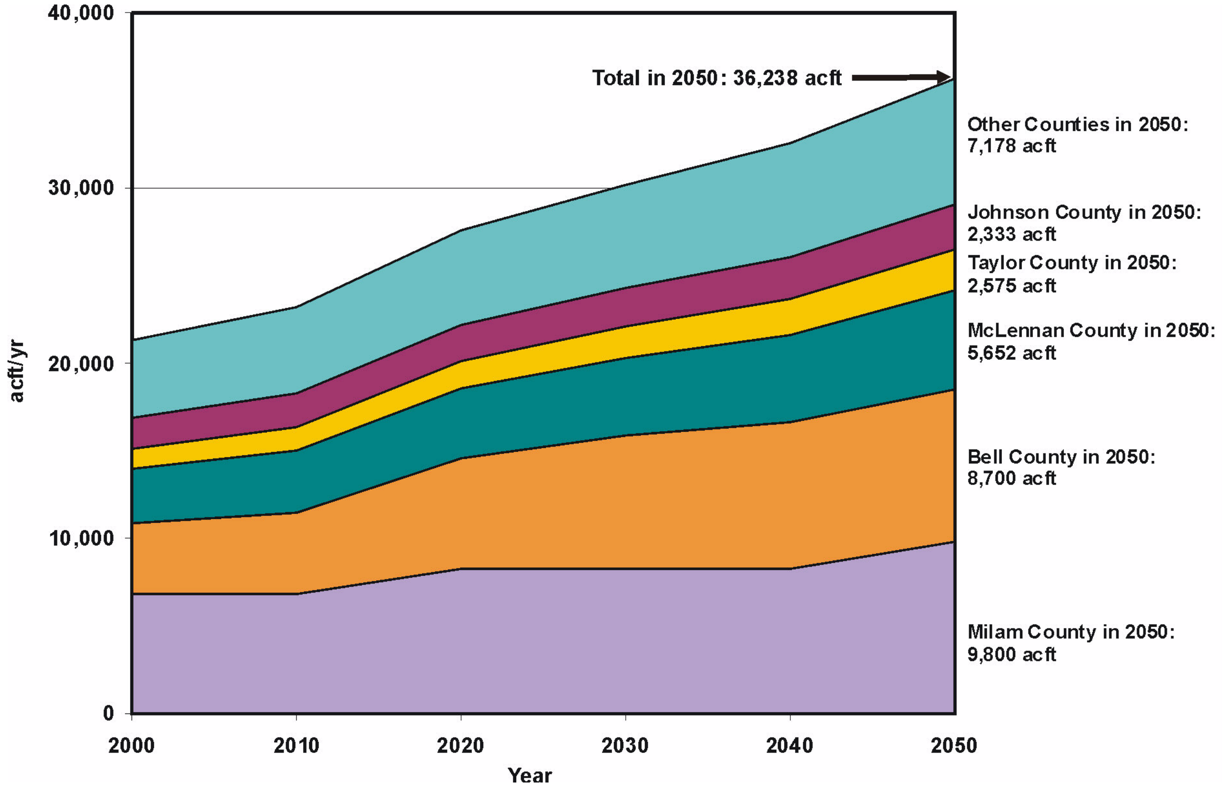


Figure 2-6. Manufacturing Water Demand Projections

96.9 percent rise (Table 2-5). This near doubling (Figure 2-7) in water use is attributable to the growing population in the region, and increased manufacturing. In addition to expansion of existing plant capacity to meet the increased needs, there are new generating plants slated to open in Bell and Bosque Counties.

2.3.4 Mining Water Demand

Projections for mining water demand are based on projected production of mineral commodities, and historic rates of water use, moderated by water requirements of technological processes used in mining.

Mining use in the Brazos G Region is expected to increase 34.4 percent between 2000 and 2050, from 40,107 acft to 53,903 acft (Table 2-6). Lee and Milam Counties account for 83.5 percent of total mining water use in 2050 (Figure 2-8). In consultation with representatives of ALCOA it was determined that water reported for manufacturing use in the 1997 Consensus

Table 2-5.
Historical and Projected Steam-Electric Water Demand by County
(acft)

County	Historical[1]		Projections[2]					
	1990	*1996*	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Bell	0	0	0	11,200	11,200	11,200	11,200	11,200
Bosque	0	0	0	5,600	5,600	5,600	5,600	5,600
Brazos	3,953	3,924	5,000	5,000	5,000	5,000	5,000	5,000
Burleson	0	0	0	0	0	0	0	0
Callahan	0	0	0	0	0	0	0	0
Comanche	0	0	0	0	0	0	0	0
Coryell	0	0	0	0	0	0	0	0
Eastland	0	0	0	0	0	0	0	0
Erath	0	0	0	0	0	0	0	0
Falls	0	0	0	0	0	0	0	0
Fisher	0	0	0	0	0	0	0	0
Grimes	11,088	6,454	10,000	20,000	20,000	20,000	20,000	20,000
Hamilton	0	0	0	0	0	0	0	0
Haskell	546	542	700	2,340	3,000	3,000	3,000	3,000
Hill	0	0	0	0	0	0	0	0
Hood	4,212	7,425	4,500	6,700	6,700	6,700	6,700	6,700
Johnson	0	0	0	0	0	0	0	0
Jones	2,041	2,635	2,340	3,556	10,324	10,324	10,324	10,324
Kent	0	0	0	0	0	0	0	0
Knox	0	0	0	0	0	0	0	0
Lampasas	0	0	0	0	0	0	0	0
Lee	0	0	0	0	0	0	0	0
Limestone	4,692	17,191	18,000	20,000	20,000	20,000	20,000	20,000
McLennan	14,366	13,155	15,000	15,000	20,000	25,000	30,000	35,000
Milam	2,716	2,804	8,680	8,680	12,500	12,500	12,500	16,000
Nolan	0	0	0	0	0	0	0	0
Palo Pinto	1,898	2,517	2,500	3,000	3,000	3,000	3,000	3,000
Robertson	0	3,740	15,000	28,000	30,000	30,000	35,000	40,000
Shackelford	0	0	0	0	0	0	0	0
Somervell	9,845	6,059	18,000	23,200	23,200	23,200	23,200	23,200
Stephens	0	0	0	0	0	0	0	0
Stonewall	0	0	0	0	0	0	0	0
Taylor	0	0	300	300	300	300	300	300
Throckmorton	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0
Williamson	0	0	0	0	0	0	0	0
Young	2,300	2,672	3,000	3,500	3,500	3,500	3,500	3,500
Total For Region	57,657	69,118	103,020	156,076	174,324	179,324	189,324	202,824

[1] Historical water use data from TWDB.
[2] Projections from TWDB or approved revision.

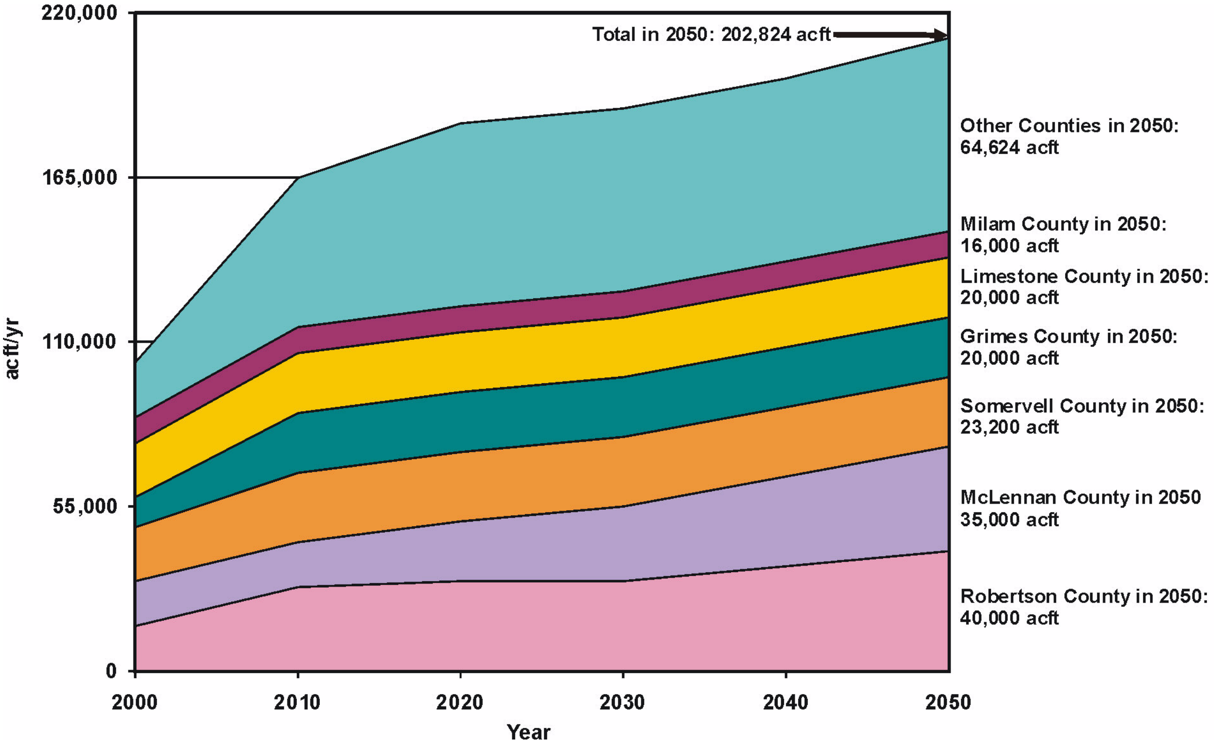


Figure 2-7. Steam-Electric Water Demand Projections

Water Plan has historically been used for mining. The revised mining water use projections reflect re-categorization of water use from the manufacturing category to the mining category. They also reflect an increase in overall mining activities, with new mining shifting to Lee County.

2.3.5 Irrigation Water Demand

The irrigation water demand projections are based on specific assumptions regarding resource constraints, crop prices, crop yields, agricultural policy, and technological advances in irrigation systems. The projections were last updated in 1993 using 1990 data. The projections do not reflect the changes in farm policy that resulted from passage of the 1996 Farm Bill.

Table 2-6.
Historical and Projected Mining Water Demand by County
(acft)

County	Historical[1]		Projections[2]					
	1990	1996	2000	2010	2020	2030	2040	2050
Bell	0	145	155	157	162	166	171	176
Bosque	61	276	301	334	381	428	475	527
Brazos	21	25	27	27	28	30	32	34
Burleson	11	29	29	24	18	15	13	13
Callahan	137	81	193	174	135	119	106	104
Comanche	74	80	87	86	89	92	95	98
Coryell	86	100	104	108	112	116	120	124
Eastland	295	81	180	120	93	86	85	77
Erath	0	0	0	0	0	0	0	0
Falls	55	133	150	111	94	88	84	86
Fisher	278	470	449	397	369	358	358	362
Grimes	0	195	273	255	236	219	213	212
Hamilton	0	0	0	0	0	0	0	0
Haskell	141	101	95	47	23	12	3	1
Hill	0	118	140	126	130	141	153	169
Hood	73	167	135	114	106	102	102	104
Johnson	27	324	335	208	154	130	114	118
Jones	169	290	289	237	217	208	205	208
Kent	799	687	736	350	175	88	29	0
Knox	11	26	20	17	15	14	13	13
Lampasas	87	193	188	175	176	179	183	189
Lee [3]	0	16	30	20,021	25,013	25,005	25,001	25,000
Limestone	0	807	941	872	913	976	1,080	1,214
McLennan	0	1,735	750	833	952	1,071	1,190	1,322
Milam [3]	7	8	30,008	20,008	20,009	20,009	20,009	20,009
Nolan	378	277	482	407	390	356	350	354
Palo Pinto	1	3	2	2	2	3	3	3
Robertson	20	94	45	45	45	45	45	45
Shackelford	279	526	433	408	398	383	379	390
Somervell	330	635	326	289	275	273	274	282
Stephens	660	7,320	448	256	171	131	104	107
Stonewall	410	14	219	181	92	53	23	17
Taylor	170	242	245	192	180	178	181	198
Throckmorton	20	40	34	28	26	25	25	26
Washington	93	109	131	125	121	119	120	124
Williamson	1,713	1,881	1,872	1,836	1,891	1,948	2,007	2,068
Young	538	159	255	179	148	134	125	129
Total For Region	6,944	17,387	40,107	48,749	53,339	53,300	53,470	53,903

1 Historical water use data from TWDB.
2 Projections from TWDB or approved revision.
3 Includes non-consumptive uses that may be available to meet other water demands.

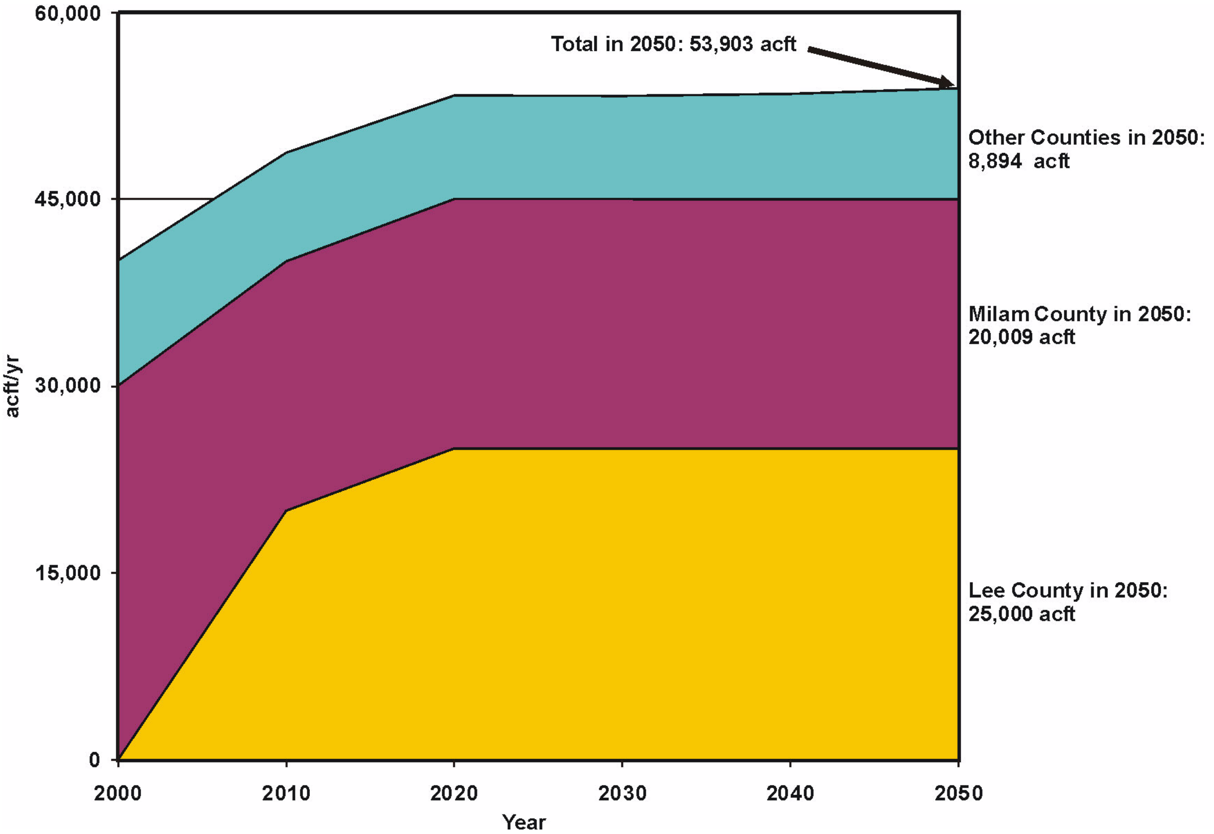


Figure 2-8. Mining Water Demand Projections

In 1997, the Brazos G Region had 181,491 acres and irrigated cropland.[2] Major crops include feed grains, small grains, cotton, pecans, and peanuts. Table 2-7 shows that irrigation water demand will decline slightly, 9.8 percent from 2000 to 2050. This is attributable to technological advances in irrigation techniques as well as projected reduction in irrigated land. Figure 2-9 shows the trend in irrigation use, with Comanche, Knox, Haskell, and Robertson Counties accounting for 63.2 percent of total irrigation water use in 2050.

2.3.6 Livestock Water Demand

In the 37-county Brazos G Region, the principal livestock type is dairy, with some beef cattle.

In the Brazos G Region there is widespread cow-calf operators, with concentrated dairy production in Comanche and Erath Counties. The livestock water demand projections are based

[2] 1997 Census of Agriculture, Volume 1, Geographic Area Services, "Table 1. County Surveying Highlights: 1997."

Table 2-7.
Historical and Projected Irrigation Water Demand by County
(acft)

County	Historical[1]		Projections[2]					
	1990	1996	2000	2010	2020	2030	2040	2050
Bell	755	1,855	745	735	725	715	706	696
Bosque	1,134	1,801	1,116	1,099	1,082	1,065	1,048	1,032
Brazos	9,875	14,475	9,399	8,945	8,514	8,103	7,712	7,340
Burleson	6,900	8,870	6,612	6,337	6,072	5,819	5,594	5,344
Callahan	662	573	651	641	630	620	610	600
Comanche	50,625	30,302	50,102	49,585	49,073	48,567	48,065	47,569
Coryell	330	1,289	277	232	195	163	137	115
Eastland	12,200	9,010	12,580	12,602	12,621	12,640	12,654	12,660
Erath	9,705	16,186	9,563	9,423	9,285	9,150	9,016	8,884
Falls	6,425	4,551	6,218	6,018	5,824	5,636	5,455	5,279
Fisher	2,591	2,361	2,514	2,439	2,366	2,295	2,227	2,160
Grimes	125	414	125	125	125	125	125	125
Hamilton	1,659	1,285	1,692	1,663	1,635	1,624	1,597	1,520
Haskell	22,320	32,154	21,656	21,012	20,388	19,782	19,193	18,623
Hill	283	565	281	279	277	275	274	272
Hood	6,926	3,980	6,797	6,670	6,545	6,423	6,303	6,185
Johnson	0	0	0	0	0	0	0	0
Jones	3,940	7,234	3,822	3,708	3,598	3,490	3,386	3,285
Kent	665	1,289	646	628	611	593	577	561
Knox	32,323	28,662	31,529	30,755	30,000	29,263	28,544	27,843
Lampasas	180	366	178	176	174	172	170	168
Lee	283	511	275	268	261	254	247	240
Limestone	0	0	0	0	0	0	0	0
McLennan	3,070	2,667	3,067	3,064	3,062	3,059	3,056	3,053
Milam	1,412	706	1,400	1,389	1,377	1,366	1,354	1,343
Nolan	1,885	3,225	1,835	1,787	1,740	1,694	1,649	1,606
Palo Pinto	479	559	473	467	461	455	450	444
Robertson	21,253	20,831	20,745	20,248	20,053	19,479	18,921	18,379
Shackelford	237	199	230	223	216	210	204	198
Somervell	350	453	348	347	345	343	342	340
Stephens	500	868	494	487	481	475	468	462
Stonewall	538	766	522	506	491	477	462	449
Taylor	486	588	475	463	453	442	432	421
Throckmorton	0	0	0	0	0	0	0	0
Washington	205	92	205	205	205	205	205	205
Williamson	160	0	160	160	160	160	160	160
Young	473	0	456	439	423	408	393	378
Total For Region	200,954	198,687	197,188	193,125	189,468	185,547	181,736	177,939

[1] Historical water use data from TWDB.
[2] Projections from TWDB or approved revision.

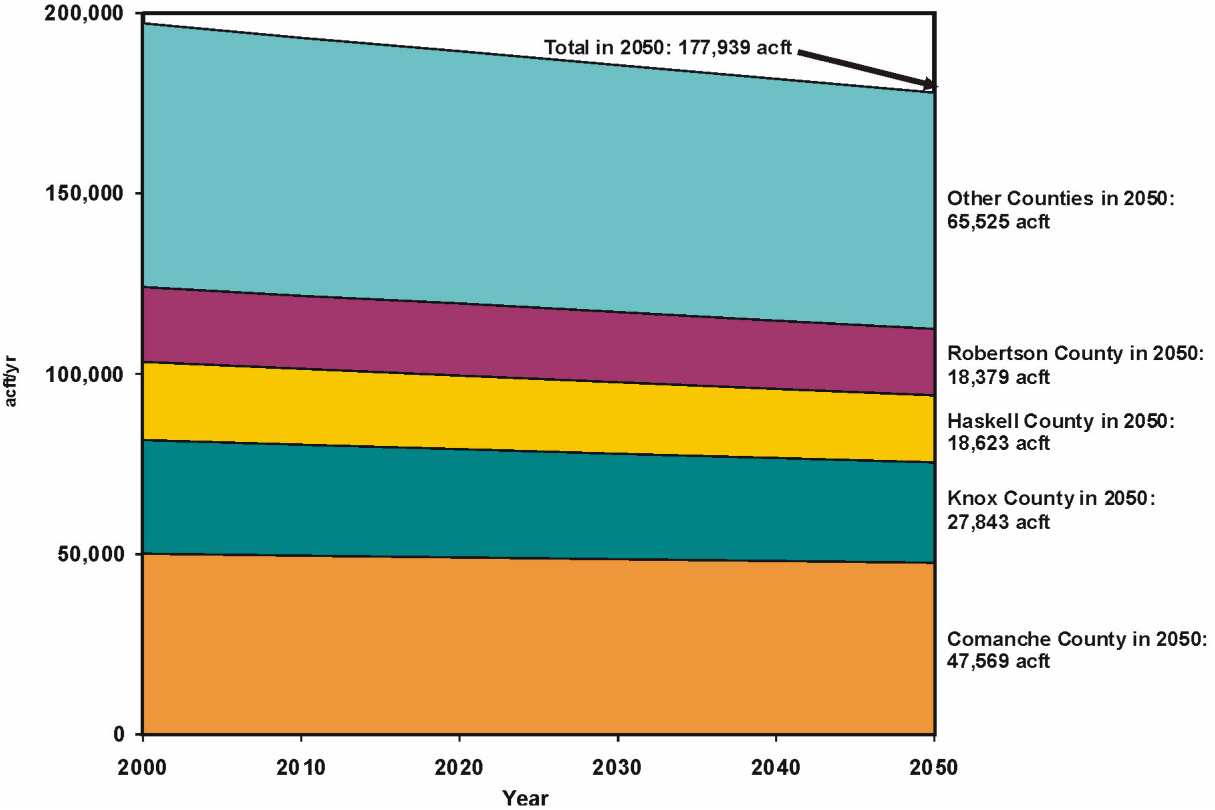


Figure 2-9. Irrigation Water Demand Projections

upon estimates of the maximum carrying capacity of the rangeland of the area and the estimated number of gallons of water per head of livestock per day. Additionally, economics of milk production and environmental impacts of the operation are major factors in the projections of the water demands for this category of livestock.

Livestock drinking water is obtained from wells, stock watering ponds, and streams. As can be seen in Table 2-8, it is projected that livestock water demand will remain constant at 53,766 acft for the 50-year planning horizon. Figure 2-10 shows the trend in livestock use, with Comanche, Taylor, and Erath Counties accounting for 26.5 percent of total livestock water use in 2050.

Table 2-8.
Historical and Projected Livestock Water Demand by County
(acft)

County	Historical[1]		Projections[2]					
	1990	1996	2000	2010	2020	2030	2040	2050
Bell	982	916	1,119	1,119	1,119	1,119	1,119	1,119
Bosque	1,228	1,836	1,160	1,160	1,160	1,160	1,160	1,160
Brazos	1,603	1,808	1,547	1,547	1,547	1,547	1,547	1,547
Burleson	1,060	1,742	1,318	1,318	1,318	1,318	1,318	1,318
Callahan	1,018	1,723	884	884	884	884	884	884
Comanche	2,355	3,590	3,181	3,181	3,181	3,181	3,181	3,181
Coryell	1,176	1,766	1,472	1,472	1,472	1,472	1,472	1,472
Eastland	915	1,817	1,144	1,144	1,144	1,144	1,144	1,144
Erath	5,898	9,730	7,400	7,400	7,400	7,400	7,400	7,400
Falls	1,773	1,743	1,368	1,368	1,368	1,368	1,368	1,368
Fisher	907	642	728	728	728	728	728	728
Grimes	1,734	1,835	1,933	1,933	1,933	1,933	1,933	1,933
Hamilton	1,468	2,564	1,811	1,811	1,811	1,811	1,811	1,811
Haskell	340	834	789	789	789	789	789	789
Hill	1,288	2,023	1,351	1,351	1,351	1,351	1,351	1,351
Hood	560	618	522	522	522	522	522	522
Johnson	1,936	2,794	2,582	2,582	2,582	2,582	2,582	2,582
Jones	521	1,762	860	860	860	860	860	860
Kent	264	470	319	319	319	319	319	319
Knox	627	442	428	428	428	428	428	428
Lampasas	660	728	984	984	984	984	984	984
Lee	1,398	1,730	1,711	1,711	1,711	1,711	1,711	1,711
Limestone	1,733	1,735	1,427	1,427	1,427	1,427	1,427	1,427
McLennan	1,588	2,103	1,873	1,873	1,873	1,873	1,873	1,873
Milam	1,901	1,798	1,627	1,627	1,627	1,627	1,627	1,627
Nolan	625	1,770	905	905	905	905	905	905
Palo Pinto	468	608	1,046	1,046	1,046	1,046	1,046	1,046
Robertson	1,587	1,763	1,704	1,704	1,704	1,704	1,704	1,704
Shackelford	768	559	760	760	760	760	760	760
Somervell	128	148	120	120	120	120	120	120
Stephens	608	1,710	773	773	773	773	773	773
Stonewall	415	523	590	590	590	590	590	590
Taylor	1,906	2,458	3,645	3,645	3,645	3,645	3,645	3,645
Throckmorton	1,166	1,729	989	989	989	989	989	989
Washington	1,605	1,833	1,504	1,504	1,504	1,504	1,504	1,504
Williamson	1,507	1,856	1,313	1,313	1,313	1,313	1,313	1,313
Young	1,054	1,718	879	879	879	879	879	879
Total For Region	46,770	65,424	53,766	53,766	53,766	53,766	53,766	53,766

[1] Historical water use data from TWDB.
[2] Projections from TWDB or approved revision.

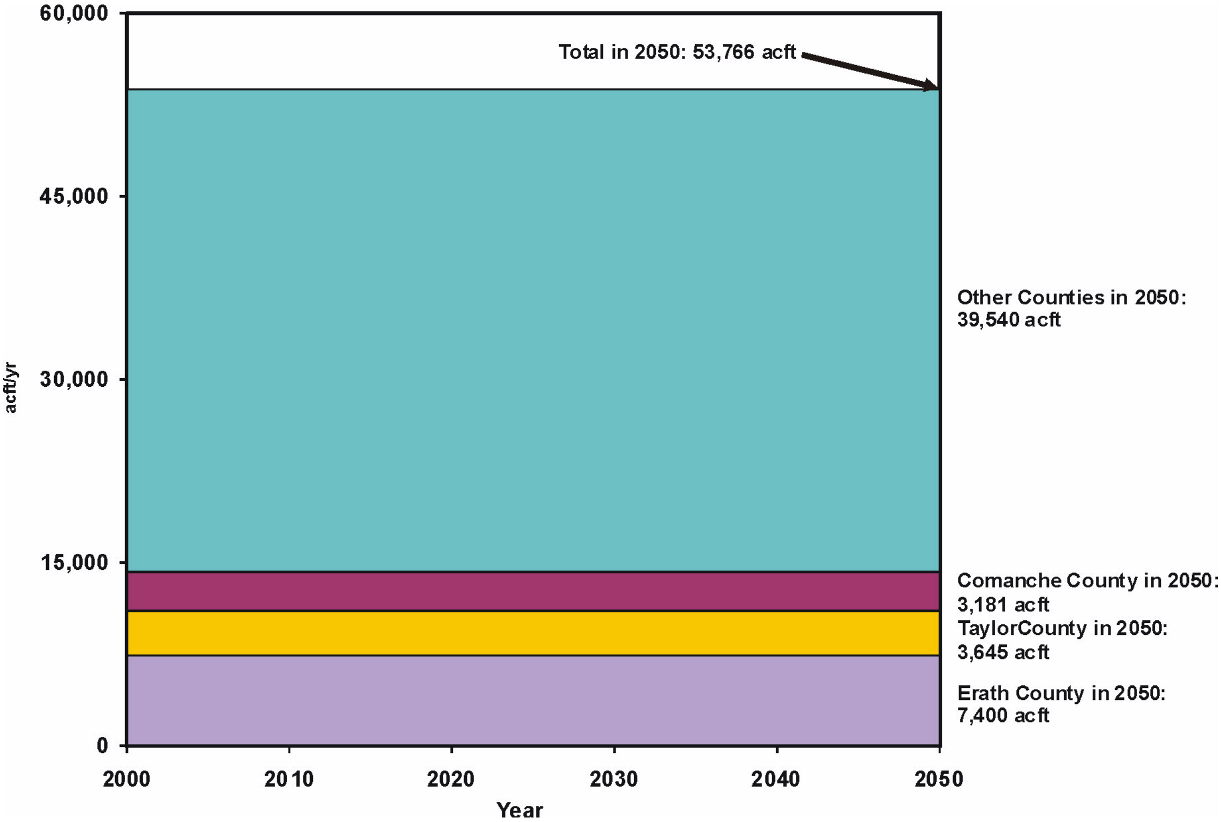


Figure 2-10. Livestock Water Demand Projections

Section 3
Evaluation of Current Water Supplies in the Region

3.1 Surface Water Supplies

Streamflow in the Brazos River and its tributaries, along with reservoirs in the Brazos River Basin, comprise a vast supply of surface water in the Brazos G Region. Diversions and use of this surface water occurs throughout the entire region with over 1,000 water rights currently issued. These water rights provide authorization for an owner to divert, store and use the water, however, they do not guarantee that a dependable supply will be available from the water source. The availability of water to a water right is dependent on several factors including hydrologic conditions (i.e., rainfall, runoff, springflow), priority date of the water right, quantity of authorized storage, and any special conditions associated with the water right (i.e., instream flow conditions, maximum diversion rate).

3.1.1 Texas Water Right System

The State of Texas owns the surface water within the state watercourses and is responsible for the appropriation of these waters. Surface water is currently allocated by the TNRCC for the use and benefit of all people of the state. Texas water law is based on the riparian and prior appropriation doctrines. The riparian doctrine extends from the Spanish and Mexican governments that ruled Texas prior to 1836. After 1840, the riparian doctrine provided landowners the rights to make reasonable use of water for irrigation or for other consumptive uses. In 1889, the prior appropriation doctrine was first adopted by Texas, which is based on the concept of “first in time is first in right.” Over the years, the riparian and prior appropriation doctrines resulted in an essentially unmanageable system. Various types of water rights existed simultaneously and many rights were unrecorded. In 1967, the Texas Legislature passed the Water Rights Adjudication Act that merged the riparian water rights into the prior appropriation system, creating a unified water permit system. The adjudication process took many years, stretching into the late 1980s before it was finally completed. In the end, Certificates of Adjudication were issued for entities recognized as having legitimate water rights. Today, individuals or groups seeking a new water right must submit an application to the TNRCC. The TNRCC determines if the water right will be issued and under what conditions. The water rights grant a certain quantity of water to be diverted and/or stored, a priority date, and other restrictions. Other restrictions may include a maximum diversion rate and instream flow restrictions to protect existing water rights and provide environmental protection.

The priority date of a water right is essential to the operation of the water rights system. Each right is issued a priority date based on the date of first capture or the appropriation date. When diverting or storing water for use, all water right holders must adhere to the priority system. A right holder must pass all water to downstream senior water rights when conditions are such that the senior water rights would not be satisfied otherwise.

3.1.2 Types of Water Rights

There are various types of water rights: Certificates of Adjudication, permits, short-term permits, or temporary permits. Certificates of Adjudication were issued in perpetuity for approved claims during the adjudication process. This type of water right was issued based on historical use rather than water availability. As a consequence, the amount of water to which rights exist exceeds the amount of water available during a drought for some streams. The TNRCC issues new permits only where normal flows are sufficient to meet the requested amount. Permits, like Certificates of Adjudication, are issued in perpetuity and may be bought and sold like other property interests. Short-term permits may be issued by the TNRCC in areas where waters are fully appropriated, but not yet being fully used. Term permits are usually issued for 10 years and may be renewed if, after 10 years, other water right holders are still not using water in the basin. Temporary permits are issued for up to 3 years. Temporary permits are issued mainly for road construction projects, where water is used to suppress dust, to compact soils, and to start the growth of new vegetation.

Water rights can include the right to divert and/or store the appropriated water. A run-of-the-river water right provides for the diversion of streamflows and does not include storage of water for use during dry periods. These rights have no authorization to store water, only the right to take water from the stream. A run-of-the-river right may be limited by streamflow, pumping rate, or diversion location.

Water rights including provisions for storage of water allow a water right holder to impound streamflows for use at a later time. The storage provides water for use during dry periods, when water may not be available due to hydrologic conditions or because current flows are required to be passed to downstream senior water rights.

While most water rights are diverted and used within the river basin of origin, water rights that divert from one river basin to another basin require an interbasin transfer permit. Several types of transfers that receive special consideration include emergency transfers, transfers of water from a river basin for use in an adjoining coastal basin (such as from the Brazos River Basin to the San Jacinto-Brazos Coastal Basin), diversions of less than 3,000 acft/yr, and diversions within any city or county that has any portion in the basin of origin.

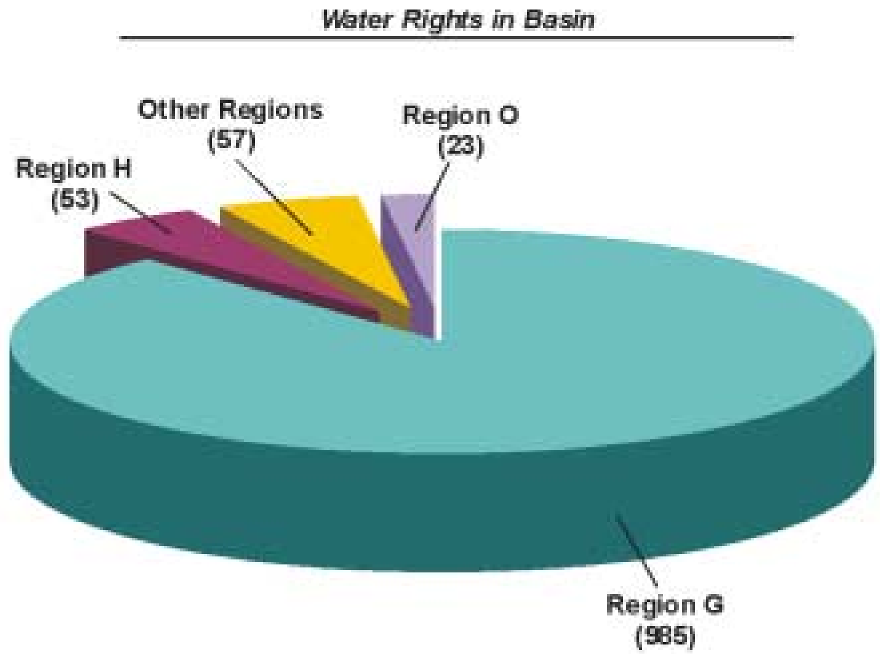
3.1.3 Water Rights in the Brazos River Basin

A total of 1,118 water rights exist in the Brazos River Basin, with a total authorized diversion of 2,266,000 acft/yr. It is important to note that a small percentage of the water rights make up a large percentage of the authorized diversion volume. In the Brazos River Basin, 39 water rights (3.4 percent) make up 2,025,000 acft/yr (89 percent) of the authorized diversion volume. The remaining 1,079 water rights primarily consist of small irrigation rights distributed throughout the river basin. Figure 3-1 shows a comparison of significant water rights in the Brazos River Basin by number of rights and diversion volume.

Figure 3-1. Comparison of Water Rights in the Brazos River Basin

Region G includes the vast majority of the water rights in the Brazos River Basin. A total of 985 water rights (88 percent) exist in Region G, making up 1,343,000 acft/yr (59 percent) of the total authorized diversion in the river basin. Region H, located downstream of Region G, has a total of only 59 water rights (4.7 percent) in the Brazos River Basin, but makes up 872,000 acft/yr (38.0 percent) of the total authorized diversions. Other regions make up a small percentage of the remaining water rights and total authorized diversion, as shown in Figure 3-2. The authorized diversions in Region H generally consist of very large, senior priority, run-of-the-river water rights. In comparison, Region G has a larger volume of water rights; however, the water rights are generally junior in priority to those downstream in Region H. Therefore, in times of drought, when streamflows are low, diversions of water from streams in Region G may be restricted for several of the water right holders. A comparison of the quantity of authorized diversions relative to the priority date of the water rights in Region G and Region H is presented in Figure 3-3. A summary of major water rights in Region G and Region H is provided in Tables 3-1 and 3-2, respectively. Major water rights are defined as having an authorized diversion of greater than 10,000 acft/yr or 5,000 acft of authorized storage. Figure 3-4 shows the location of major water rights in the Brazos River Basin, and a list of all water rights, summarized by County and Planning Region, is provided in Appendix G.1 and G.2.

While Region H includes a large quantity of senior priority water rights, most of these water rights have very little storage associated with them and, therefore, may be described primarily as run-of-the-river water rights. The water rights in Region G are generally junior to those water rights in Region H; however, there is a substantial volume of reservoir storage associated with the water rights in Region G to provide a firm supply. The total authorized storage in the Brazos River Basin is 3,969,000 acft, with 3,626,000 acft (91 percent) located in Region G. In Region H, the quantity of reservoir storage is 86,000 acft, or 2.2 percent of the total authorized storage volume in the river basin. The large quantity of reservoir storage in Region G provides for a firm supply of water during drought conditions, when streamflows are low and may be required to be passed through to downstream senior water rights in Region H. Figure 3-5 presents a comparison of the total authorized storage and annual diversion volume for Region G and Region H.



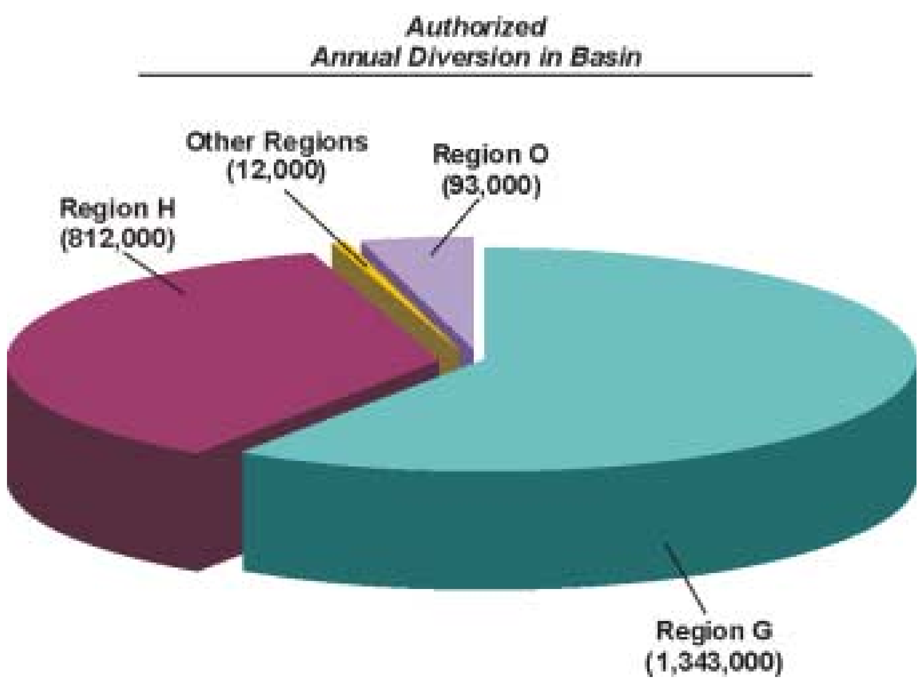


Figure 3-2. Comparison of Significant Water Rights in the Brazos River Basin by Number of Rights and Diversion Volume

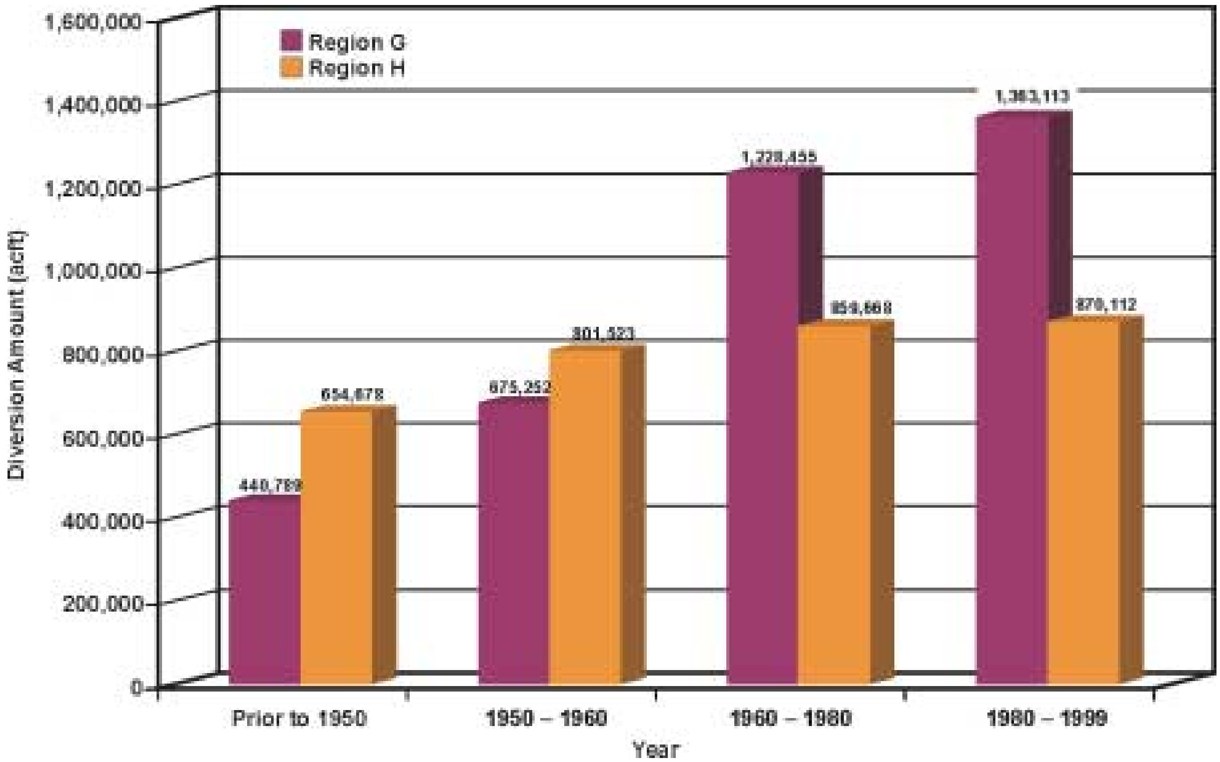


Figure 3-3. Comparison of Cumulative Diversion Volume and Priority Date for Regions G and Region H

Table 3-1.
Major Water Rights in Region G Brazos Basin

Water Right No.	*Name*	*Annual Diversion Volume (acft/yr)*	*Reservoir Storage Capacity (acft)*	*Priority Date*	*Facility*	*County*
003758	Aluminum Co of America	18,000		12/12/51	Lake Alcoa	Milam
005272	Aluminum Co of America	14,000	15,650	12/12/51	Lake Alcoa	Milam
005287	Bistone Municipal WSD	2,887	9,600	4/15/57	Lake Mexia	Limestone
		65		4/15/57		Limestone
	Total	2,952	9,600			
002939	Brazos Electric Cooperative	38,800		2/7/49	Poage Plant	Bell
005155	Brazos River Authority	230,750	724,739	4/6/38	Possum Kingdom Lake	Palo Pinto
005156	Brazos River Authority	64,712	155,000	2/13/64	Lake Granbury	Hood
005157	Brazos River Authority	18,336	50,000	8/30/82	Lake Whitney	Hill
005158	Brazos River Authority	13,896	52,400	10/25/76	Lake Aquilla	Hill
005159	Brazos River Authority	19,658	59,400	12/16/63	Lake Proctor	Comanche
005160	Brazos River Authority	100,257	457,600	12/16/63	Lake Belton	Bell
005161	Brazos River Authority	67,768	235,700	12/16/63	Lake Stillhouse Hollow	Bell

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Table 3-1 (continued)

Water Right No.	*Name*	*Annual Diversion Volume (acft/yr)*	*Reservoir Storage Capacity (acft)*	*Priority Date*	*Facility*	*County*
005162	Brazos River Authority	13,610	37,100	2/12/68	Lake Georgetown	Williamson
005163	Brazos River Authority	19,840	65,500	2/12/68	Lake Granger	Williamson
005164	Brazos River Authority	48,000	160,110	12/16/63	Lake Somerville	Washington
005165	Brazos River Authority		217,494	5/6/74	Lake Limestone	Robertson
		65,074	7,906	9/4/79	Lake Limestone	Robertson
	Total	65,074	225,400			
004139	City of Abilene		60	8/3/49		Jones
		30,000	548	8/22/55	Diversion from Clear Fork of Brazos R.	Jones
	Total	30,000	608			
004161	City of Abilene	30,690	73,960	3/25/37	Fort Phantom Hill	Jones
002938	City of Temple	15,804	500	10/30/15		Bell
		20,000	___	1/11/57		Bell
	Total	35,804	500			
002315	City of Waco	39,100	104,100	1/10/29	Lake Waco	McLennan
		19,100	______	4/16/58	Lake Waco	
		900	______		Lake Waco	McLennan
005099	Brazos River Authority	20,770	87,962	9/12/86	Lake Waco Enlargement	
	Total	79,870	192,062			
004031	Palo Pinto Co MWD 1	10,000	34,250	7/3/62	Lake Palo Pinto	Palo Pinto
		6,000		7/3/62		Palo Pinto
		2,500	9,874	9/8/64		Palo Pinto
	Total	18,500	44,124			
004097	Texas Utilities Electric Co	23,180	151,500	4/25/73	Squaw Creek Reservoir	Somervell
004342	Texas Utilities Electric Co	12,000	37,800	8/21/26	Tradinghouse Steam Electric Station	McLennan
		15,000	_____	9/16/66	Tradinghouse Steam Electric Station	McLennan
	Total	27,000	37,800			
004345	Texas Utilities Electric Co		8,000	3/6/51	Lake Creek Steam Electric Station	McLennan
		10,000	500	3/5/52	Lake Creek Steam Electric Station	McLennan
	Total	10,000	8,500			
005298	Texas Utilities Electric Co	13,200	30,319	7/1/74	Twin Oak Steam Electric Station	Robertson
002936	US Dept of Army	10,000	12,000	8/24/53	Lake Belton	Bell
		2,000	_____	8/23/54		Bell
	Total	12,000	12,000			
004213	West Central Texas MWD	52,800	317,750	5/28/57	Hubbard Creek Lake	Stephens
		3,200	______	8/14/72		Stephens
	Total	56,000	317,750			
	Total	1,045,227	2,868,642			

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Table 3-2.
Water Rights in Region H, Downstream of Region G Brazos River Basin

Water Right Number	Name	Annual Diversion Volume (ac-ft/yr)	Reservoir Storage Capacity (ac-ft)	Priority Date	Facility	County
005168	Gulf Coast Water Authority	99,932		1/15/26		Fort Bend
005171	Gulf Coast Water Authority	75,000		2/1/39		Fort Bend
		50,000		12/12/50		Fort Bend
	Total	125,000				
005320	Richmond Irrigation Co	12,000		10/23/26		Fort Bend
		28,000		10/23/26		Fort Bend
	Total	40,000				
005322	Chocolate Bayou Water Co	10,000	864	2/8/29		Fort Bend
		145,000	0	2/8/29		Fort Bend
	Total	155,000	864			
005325	Houston L&P	28,711	18,750	12/16/55	Smithers Lake	Fort Bend
005328	Dow Chemical Co	20		4/4/60		Brazoria
		3,136		3/8/76		Brazoria
		20,000		2/28/29		Brazoria
		150,000		2/14/42		Brazoria
			10,200	2/14/42	Harris Reservoir -- Off-Channel	Brazoria
		7,500	600	4/3/51	Buffalo Camp	Brazoria
			21,700	4/7/52	Brazoria Reservoir — Off-Channel	Brazoria
		65,000		4/4/60		Brazoria
		1,800		2/14/42		Brazoria
		58,175	30	2/14/42	Oyster Creek Reservoir	Brazoria
	Total	305,631	32,530			
005332	US Department of Energy	52,000		4/27/81	Bryan Mound SPR Site	Brazoria
005366	Brazosport Water Authority	45,000		4/4/60		Brazoria
	Total	851,274	52,144			

A total of 48 major reservoirs, with a capacity greater than 5,000 acft, exist in the river basin. The U.S. Army Corps of Engineers owns several of these reservoirs in the basin, including Lake Georgetown, Lake Aquilla, Lake Granger, Lake Proctor, Lake Somerville, Lake Waco, Lake Belton, Lake Stillhouse Hollow, and Lake Whitney. These reservoirs were built for the primary purpose of flood control, however, they also included other benefits including water supply. For purposes of water supply, the USCOE has contracted conservation storage in each reservoir to the BRA. The BRA owns the water right permit for each reservoir and manages the

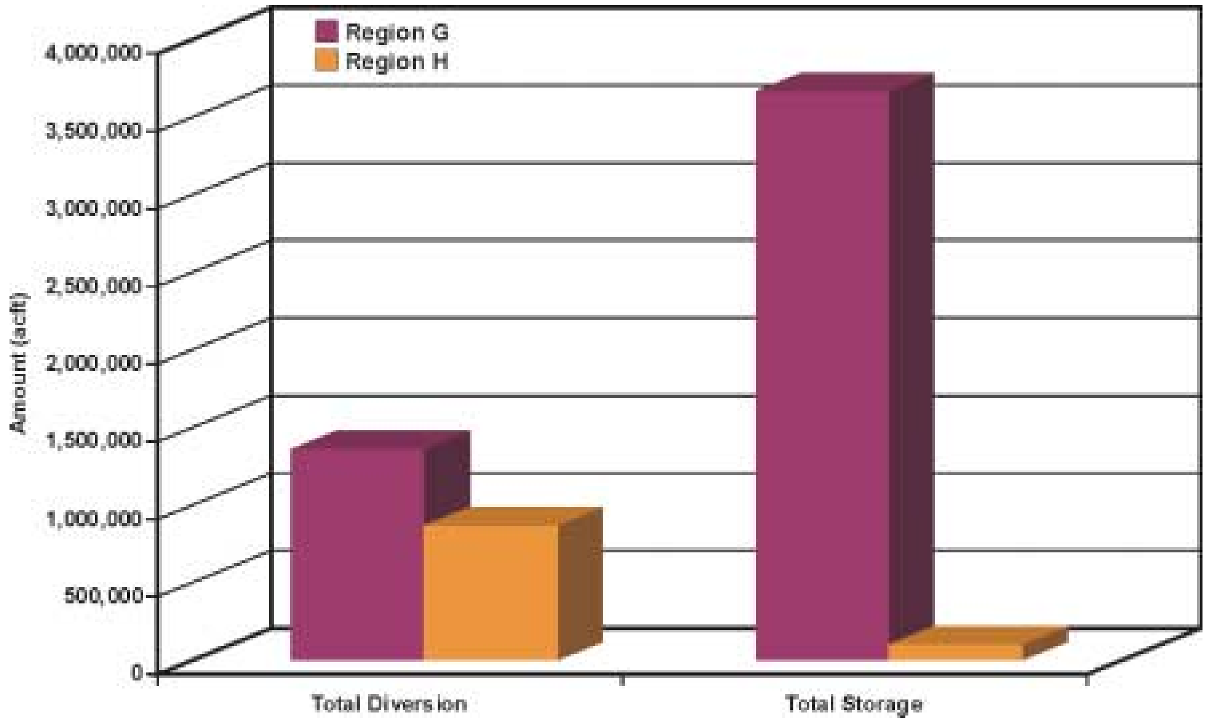

Figure 3-5. Comparison of Storage and Diversion Volume for Regions G and H

water supply conservation storage in each reservoir. Other major reservoirs in the basin that provide municipal, industrial, and irrigation water supply are owned by the BRA, City of Waco, City of Abilene, City of Mineral Wells, Palo Pinto County MWD No. 1, West Central Texas MWD, City of Cisco, City of Breckenridge, City of Sweetwater, City of Cleburne, and City of Stamford. A summary of major reservoirs in the Brazos River Basin is presented in Table 3-3 and the locations of the reservoirs were shown in Figure 3-4.

A number of interbasin transfer permits exist in the Brazos River Basin. These permits include both authorizations for diversions from the Brazos River Basin to adjacent river basins and from adjacent river basins to the Brazos River Basin. Most of the interbasin transfer permits are obviously located along the basin divide. Examples of interbasin transfers that authorize diversions from an adjacent river basin to the Brazos River Basin include: Lake Meredith (Canadian River Basin) to the Lubbock and Plainview areas in Lubbock and Hale County; Oak Creek Reservoir (Colorado River Basin) to the City of Sweetwater in Nolan County; and Lake Travis (Colorado River Basin) to the City of Cedar Park in Williamson County. Interbasin

Table 3-3. Major Reservoirs[1] of the Brazos River Basin

Reservoir	Water Right Owner	Authorized Storage (acft)	Authorized Diversion (acft)	Priority Date	County	Planning Region
Abilene	City of Abilene	11,868	1,675	1/23/18	Taylor	G
Alcoa Lake	Aluminum Co. of America	15,650	14,000	12/12/51	Milam	G
Alan Henry	Brazos River Authority	115,937	35,200	10/5/81	Garza	O
Aquilla	Brazos River Authority	52,400	13,896	10/25/76	Hill	G
Belton	Brazos River Authority	457,600	100,257	12/16/63	Bell	G
Brazoria Reservoir–Off-Channel	Dow Chemical	21,700	0	4/7/52	Brazoria	H
Cisco	City of Cisco	45,000	1,971	4/16/20	Eastland	G
			56	9/5/78		
Daniel	City of Breckenridge	11,400	2,100	4/26/46	Stephens	G
Dansby Power Plant	City of Bryan	15,227	850	5/30/72	Brazos	G
Eagle Nest Lake	T L Smith Trust Et Al	18,000	4,000	1/15/48	Brazoria	H
		11,315	1,800	9/9/93		
Fort Phantom Hill	City of Abilene	73,960	30,690	3/25/37	Jones	G
Georgetown	Brazos River Authority	37,100	13,610	2/12/68	Williamson	G
Gibbons Creek Power	Texas Municipal Power	26,824	9,740	2/22/77	Grimes	G
		5,260		3/9/89		
Graham/Eddleman	City of Graham	4,503	5,000	11/21/27		
		39,000	15,000	11/15/54	Young	G
		8,883		9/16/57		
Granbury	Brazos River Authority	155,000	64,712	2/13/64	Hood	G
Granger	Brazos River Authority	65,500	19,840	2/12/68	Williamson	G
Harris Reservoir–Off-Channel	Dow Chemical	10,200	0	2/14/42	Brazoria	H
Hubbard Creek Lake	West Central Texas MWD	317,750	52,800	5/28/57	Stephens	G
			3,200	8/14/72		
Leon	Eastland Co WSD		1,265	5/17/31		
		28,000	2,438	3/21/52	Eastland	G
			2,598	3/25/86		
Limestone	Brazos River Authority	217,494	65,450	5/1/74	Robertson	G
		7,906		9/4/79		
Miller's Creek	North Central Texas MWA	30,696	5,000	10/1/58	Baylor	B
Palo Pinto	Palo Pinto Co. MWD 1	34,250	10,000	7/3/62	Palo Pinto	G
		9,874	2,500	9/8/64		
			6,000	7/3/62		
Pat Cleburne Reservoir	City of Cleburne	25,600	5,760	8/6/62	Johnson	G
			240	3/29/76		
Possum Kingdom	Brazos River Authority	724,739	230,750	4/6/38	Palo Pinto	G
Proctor	Brazos River Authority	59,400	19,658	12/16/63	Comanche	G

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Table 3-3 (continued)

Reservoir	Water Right Owner	Authorized Storage (acft)	Authorized Diversion (acft)	Priority Date	County	Planning Region
Smithers Lake	Houston L&P	18,750	28,711	12/16/55	Fort Bend	H
Somerville	Brazos River Authority	160,110	48,000	12/16/63	Washington	G
Squaw Creek Reservoir	Texas Utilities Electric Co.	151,500	23,180	4/25/73	Somervell	G
Stamford	City of Stamford	60,000	10,000	6/8/49	Haskell	G
Stillhouse Hollow	Brazos River Authority	235,700	67,768	12/16/63	Bell	G
Sweetwater	City of Sweetwater	10,000	3,740	10/17/27	Nolan	G
Tradinghouse Steam	Texas Utilities Electric Co.	37,800	12,000	8/21/26	McLennan	G
			15,000	9/16/66		
Twin Oak Steam Electric	Texas Utilities Electric Co.	30,319	13,200	7/1/74	Robertson	G
Waco	City of Waco	104,100	39,100	1/10/29	McLennan	G
			19,100	4/16/58		
			900	2/21/79		
	Brazos River Authority	87,962	20,770	9/12/86		
Whitney	Brazos River Authority	50,000	18,336	8/30/82	Hill	G
White River Reservoir	White River MWD	33,160	6,000	9/22/58	Crosby	O
		5,072		11/21/60		
		6,665		8/16/71		

[1] Major Reservoirs are defined as having a capacity greater than 10,000 acft

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transfers authorized for diversion from the Brazos River Basin to other river basins include: Lake Mexia in Limestone County to part of the City of Mexia that lies in the Trinity River Basin; Teague City Lake in Freestone County to part of the City of Teague that lies in the Trinity River Basin; and Lake Granbury in Hood County to part of Johnson County that lies in the Trinity River Basin. A summary of interbasin transfers associated with the Brazos River Basin is presented in Table 3-4.

3.1.4 Water Supply Contracts

Many entities within Region G obtain surface water through water supply contracts. These supplies are usually obtained from entities that have surface water rights to provide a specific quantity of water each year to a buyer for an established unit price. The BRA is the largest provider of water supply contracts in Region G with 661,901 acft/yr permitted from its system of reservoirs in the Brazos River Basin. The BRA contracts raw water to various entities for long-term supply as well as short-term supply for municipal, industrial, and irrigation uses.

Table 3-4.
Summary of Interbasin Transfers
Associated with the Brazos River Basin

River Basin of Origin	Location of Use			Description	Authorized Diversion (acft/yr)	Priority Date
	River Basin	Planning Region	County			
Brazos	Trinity	G	Johnson	Lake Granbury to Johnson County	2,600	11/7/86
Brazos	Trinity	G	Limestone	Lake Mexia to part of Mexia	N/A	N/A
Brazos	Trinity	C	Freestone	Teague City Lake to part of Teague	N/A	N/A
Brazos	Colorado	G	Lampasas	Brazos River to City of Lampasas	180	6/23/14
Brazos	Trinity	N/A	N/A	Lake Possum Kingdom to Trinity Basin	5,240	4/6/38
Canadian	Brazos	O	Lubbock	Lake Meredith to Lubbock Co. Area	151,200	1/30/56
Colorado	Brazos	G	Fisher	Lake J B Thomas to Fisher Co.	N/A	N/A
Colorado	Brazos	G	Nolan	Oak Creek Res. to Lk Trammel/Sweetwater	3,000	N/A
Colorado	Brazos	G	Callahan	Lake Clyde to Clyde	200	2/2/65
Colorado	Brazos	G	Taylor	Lake O H Ivie to Abilene	15,000	2/2/78
Colorado	Brazos	G	Williamson	Lake Austin to Williamson Co.	N/A	N/A
Colorado	Brazos	G	Williamson	Lake Travis to Cedar Park	16,500	N/A
Colorado	Brazos	G	Williamson	Lake Travis to Leander	6,400	N/A
Colorado	Brazos	F	Fisher	Snyder to City of Rotan	N/A	N/A
Red	Brazos	B	Archer	Small Lakes to Megargel	N/A	N/A
Red	Brazos	B	Archer	Lake Cooper & Olney to Olney	35	8/11/80
Red	Brazos	O	Floyd	Lake MacKenzie to Floydada & Lockney	N/A	N/A
Trinity	Brazos	C	Parker	Lake Weatherford to part of Weatherford	N/A	N/A

Other water right holders that contract large quantities of raw water supply to other entities include the West Central Texas MWD and the Palo Pinto County MWD No. 1. The West Central Texas MWD contracts raw water from Lake Hubbard Creek for municipal use to the City of Abilene, Albany, Anson, and Breckenridge. The City of Abilene contracts raw water from Fort Phantom Hill Reservoir to West Texas Utilities for industrial use as well as municipal supply to several other surrounding cities and water supply corporations. The Palo Pinto County MWD No. 1 contracts raw water from Lake Palo Pinto for industrial use to Brazos Electric Co-op. A summary of the BRA's existing long-term raw water supply contracts in Region G is presented in Table 3-5. A detailed list of BRA's existing long-term water supply contracts is provided in Appendix G.4.

Table 3-5.
Summary of the Brazos River Authority
Long-term Water Supply Contracts[1]

Reservoir	Municipal Use (acft)	Industrial Use (acft)	Irrigation Use (acft)	Total Contracts (acft)
Aquilla	11,403	0	0	11,403
Belton	100,032	0	200	100,232
Georgetown	13,440	0	0	13,440
Granbury	22,790	40,000	0	62,790
Granger	8,525	5,000	15	13,540
Limestone	8,209	46,600	0	54,809
Possum Kingdom	20,975	117,142	570	138,687
Proctor	7,889	0	10,270	18,158
Somerville	4,619	0	0	4,619
Stillhouse	67,286	300	182	67,768
Whitney	5,450	0	60	5,510
System	32,668	99,000	5,625	137,293
Total	303,286	308,042	16,922	628,250

[1] Brazos River Authority Long-Term Water Supply Contracts as of 12/1/99

3.2 Reliability of Supply

Hydrologic conditions are a primary factor that affects the reliability of a water right. Severe drought periods have been experienced in all areas of Region G in the Brazos River Basin. The drought of record for most areas of Region G occurred in the 1950s with other smaller duration drought periods occurring in the 1960s, 1970s, 1980s and even recently in the 1990s. Figure 3-6 shows annual streamflow for the Brazos River at South Bend (Young County) in the upper part of Region G. The median annual streamflow for the period 1939 to 1998 at this location is 492,900 acft/yr. The minimum annual streamflow of 48,980 acft/yr occurred in 1952. It is important to note that a severe drought period began in 1993 and continues today. The average streamflow over the 6-year period of 1993 to 1998 of 302,700 acft/yr is the lowest average streamflow recorded over any 6-year period at the South Bend gage, representing 61 percent of the median annual streamflow.

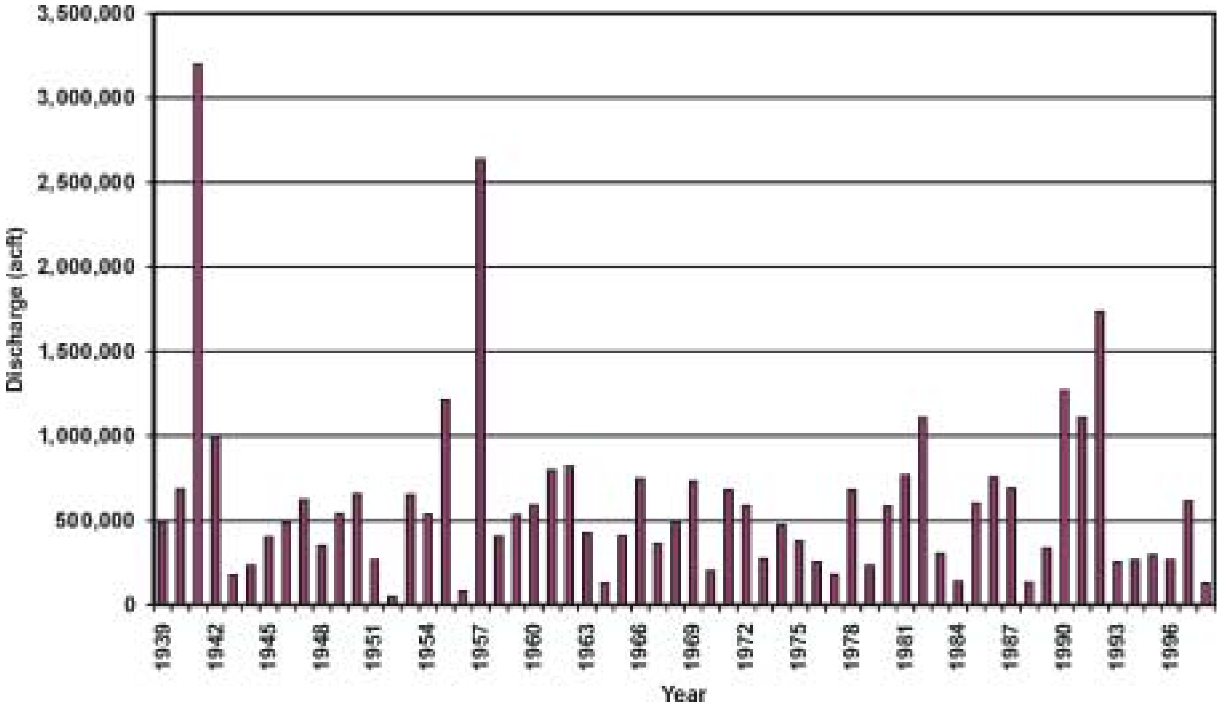

Figure 3-6. Annual Discharge at Brazos River South Bend Gage

At the lower end of the region, drought conditions were most severe during the drought of the 1950s. Over the period of 1924 to 1999, the median annual streamflow recorded for the Brazos River at Richmond (Fort Bend County) was 5,485,800 acft/yr (Figure 3-7). During the drought of the 1950s, streamflow averaged 1,700,000 acft/yr, or 31 percent of the median annual streamflow. The minimum annual streamflow of 892,000, 16 percent of the median streamflow, occurred in 1951 at Richmond. These two gages, located at opposite ends of Region G are indicative of the types of extremes that occur throughout the region, including tributary streams.

Water rights downstream of Region G, located in Region H, also play a role in determining the reliability of supply in Region G. These water rights are located along the coastal region and represent some of the largest and most senior priority water rights in the Brazos River Basin. The senior priority of these water rights relative to other water rights in the Brazos River Basin require that flows at their diversion point be adequate to provide sufficient water to meet the permitted diversion. If flows are insufficient at their respective diversion points, then water rights located upstream that are junior in priority may be restricted from diverting or impounding flow.

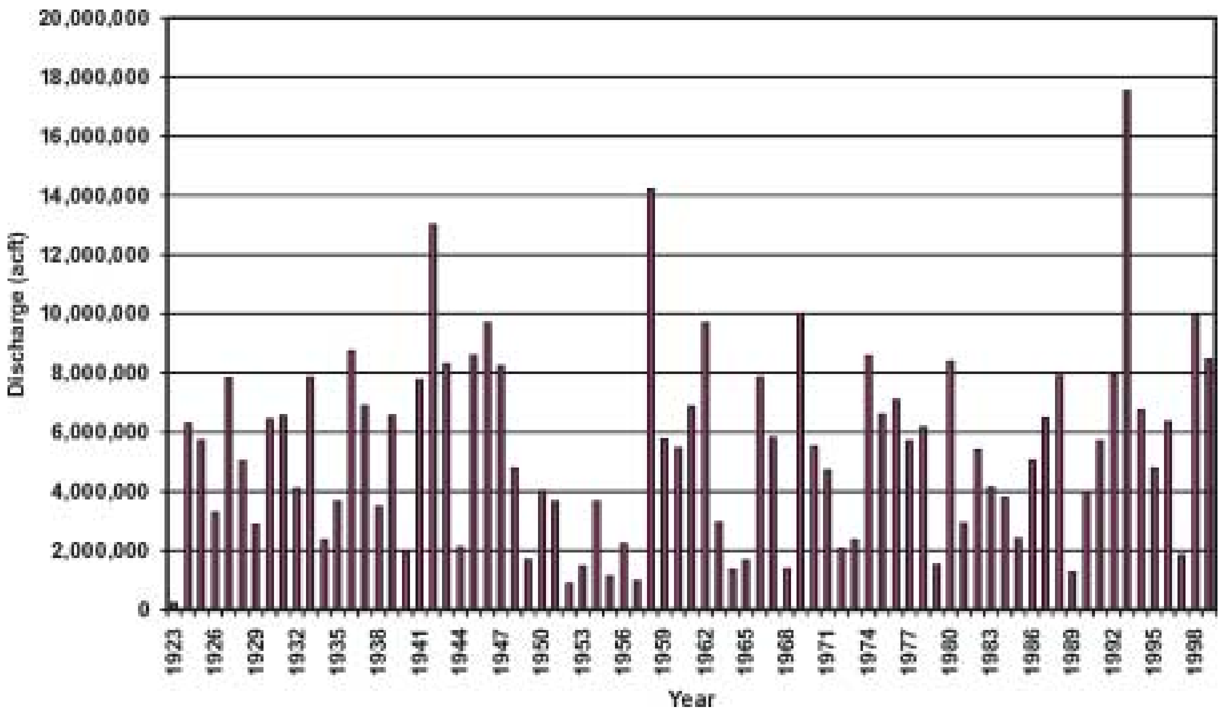

Figure 3-7. Annual Discharge at Brazos River Richmond Gage

The reliability of a water right is typically represented in terms of the percent of time that a specific quantity of water is available for diversion and use. Municipal and industrial water suppliers typically require a very high reliability for their water sources. In most cases, interruption to water supply is not acceptable, requiring the reliability of the supply to be 100 percent of the time. Municipal and industrial supplies are commonly based on firm yield. Firm yield is defined as the quantity of water that can be diverted for use during a repeat of the most severe drought of record without interruption of service. In some cases, municipalities have decided to use safe yield as a measurement of reliability of supply. Safe yield is defined as the amount of water that can be diverted for use during a repeat of the most severe drought of record without interruption of service and with a 1-year supply of water in reserve (reservoir storage). For purposes of this study, firm yield was used for municipal water supplies in order to provide a common basis for comparison.

The firm yield of run-of-the-river water rights was based on the minimum annual supply that could be diverted over a historical period of record. For reservoirs, the firm yield may decrease over time as a result of sedimentation. Rivers and streams naturally carry sediment from upstream to downstream. When a reservoir is constructed on the stream channel, the sediment will fall out of solution and accumulate on the floor and walls of the reservoir. This accumulation reduces the volume of water that can be stored in the reservoir, which in turn, reduces the firm yield available for diversion. Sedimentation rates have been measured for several reservoirs over a period of time and estimated sedimentation rates have been made for other reservoirs. For the 50-year planning period, the reduction in firm yield for future sedimentation was considered where data was available. Firm yield for existing reservoirs is presented for the year 2000 and for the year 2050.

3.3 Water Availability

3.3.1 Methods of Determining Water Availability

Determination of water availability for existing water rights is based on a rather complex function of location, hydrologic conditions, diversion volume, reservoir storage, and priority date. Computer models that are capable of analyzing these inter-relationships are typically employed to determine water availability for water rights. For this study, detailed site-specific engineering studies were referenced for water availability and firm yield data for existing water rights when they were available. Sources of this data for existing water rights included the BRA, TWDB, and private consulting engineers. Where no site-specific studies existed for reservoirs and run-of-the-river water rights, water availability estimates were developed using a computer model for the Brazos River Basin. The Water Rights Analysis Package (WRAP) computer model was developed at Texas A&M University for the Brazos River Basin. The WRAP model is designed for use as a water resources management tool. The model can be used to evaluate the reliability of existing water rights and to determine unappropriated streamflow potentially available for a new water right permit. WRAP simulates the management and use of streamflow and reservoirs over a historical period of record, adhering to the water right priority system. Water availability computations are performed at 18 control points located throughout the river basin. The control points for the Brazos River Basin WRAP model are located at Lake Hubbard, South Bend streamgage (Brazos River), Lake Possum Kingdom, Lake Granbury, Lake Whitney, Lake Waco, Lake Aquilla, Lake Proctor, Lake Belton, Lake Stillhouse Hollow, Lake Georgetown, Lake Granger, Cameron streamgage (Little River), Lake Somerville, Bryan streamgage (Brazos River), Hempstead streamgage (Brazos River), Lake Limestone, and the

Richmond streamgage (Brazos River). Figure 3-8 shows the location of the control points for the Brazos River Basin WRAP model.

The model performs calculations at each control point. Flows over the historical period of 1900 to 1984 were simulated, accounting for water right diversions and reservoir operations. All water rights in the Brazos River Basin were included in the model. Water rights data available from the TNRCC was revised and updated in the WRAP model after a thorough review of Certificates of Adjudication and permits for major water rights in the river basin. For reservoirs, the year 2050 firm yield was used in the model for computation of water availability to existing water rights. A summary of firm yield data for major reservoirs in the WRAP model is presented in Table 3-6.

3.3.2 WRAP Model Results for Existing Water Rights

The results of the WRAP Model include water availability estimates for each water right. Summaries of water available to municipal and industrial run-of-the-river water rights (including small reservoirs) is presented in Tables 3-7 and 3-8, respectively. Water availability is expressed in terms of the minimum annual supply, which is defined as the water available during the most severe drought year over the 85-year simulation period of 1900 to 1984. Water availability estimates for irrigation water rights and other uses were grouped by county in the Brazos River Basin. For irrigation water rights, the minimum annual supply and the quantity of water that is available 75 percent of the time were calculated. The results of water availability for each county for each type of use are presented in Table 3-9.

3.3.3 WRAP Model Results for Unappropriated Flow

Water potentially available to a new water right permit was calculated by the WRAP Model at each model control point. This unappropriated flow was computed assuming no instream flow restrictions and all existing water rights are fully exercised. Unappropriated flow was computed for each month of each year for the 1900 to 1984 simulation period. The quantity of unappropriated flow varies throughout the river basin depending on the control point location. Summaries of unappropriated flow for the Brazos River at the South Bend gage and Richmond gage are shown in Figure 3-9 and Figure 3-10, respectively. These two control points represent the conditions at the extreme upper and lower ends of the river basin. As shown in Figure 3-9, unappropriated flow is not available at the South Bend gage location for most years, especially

Table 3-6.
Firm Yields for Major Reservoirs in Brazos Basin

Reservoir	Water Right Owner	County	Year 2000 Yield	Year 2050 Yield
Abilene[1]	City of Abilene	Taylor	1,450	1,120
ALCOA[2]	ALCOA	Milam	9,002	9,002
Alan Henry[3]	Brazos River Authority	Garza	26,100	20,600
Aquilla[3,4]	Brazos River Authority	Hill	13,478	5,114
Belton[3]	Brazos River Authority	Bell	106,511	103,961
Pat Cleburne[12]	City of Cleburne	Johnson	5,890	5,210
Cisco[1]	City of Cisco	Eastland	500	370
Lake Creek Steam-Electric[5]	Texas Utilities	McLennan	4,858	4,858
Daniel[6]	City of Breckenridge	Stephens	2,500	2,100
Dansby Power Plant[7]	City of Bryan	Brazos	0	0
Graham/Eddleman[8]	City of Graham	Young	8,400	8,400
Fort Phantom Hill[9]	City of Abilene	Jones	26,872	26,012
Georgetown[3]	Brazos River Authority	Williamson	14,711	14,609
Gibbons Creek[7]	Texas Municipal Power	Grimes	0	0
Granbury[3]	Brazos River Authority	Hood	66,819	62,790
Granger[3]	Brazos River Authority	Williamson	19,220	13,540
Hubbard Creek[9]	West Texas MWD	Stephens	43,399	38,349
Kirby[8]	City of Abilene	Taylor	300	300
Leon[1]	Eastland Co. WSD	Eastland	4,500	2,500
Limestone[3]	Brazos River Authority	Robertson	64,646	58,475
Mexia[2]	Bistone Municipal WSD	Limestone	4,111	100
Miller's Creek[1]	North Central Texas MWA	Baylor	3,100	2,034
Mineral Wells[8]	City of Mineral Wells	Parker	1,500	1,500
Palo Pinto[10]	Palo Pinto MWD No. 1	Palo Pinto	14,560	12,233
Possum Kingdom[3]	Brazos River Authority	Palo Pinto	263,253	252,288
Post Dam (North Fork) [1]	White River MWD	Garza	10,600	10,600
Proctor[3]	Brazos River Authority	Comanche	21,897	20,826
Somerville[3]	Brazos River Authority	Washington	41,191	38,641
Squaw Creek[7]	Texas Utilities	Somervell	0	0
Stamford[13]	City of Stamford	Haskell	2,930	2,350
Stillhouse Hollow[3]	Brazos River Authority	Bell	71,044	68,137
Sweetwater[1]	City of Sweetwater	Nolan	1,400	467
Tradinghouse[5]	Texas Utilities	McLennan	12,000	12,000
Twin Oaks[7]	Texas Utilities	Robertson	0	0
Waco[11]	City of Waco	McLennan	81,120	79,870
White Reservoir[1]	White River MWD	Crosby	4,000	3,870
Whitney[3]	Brazos River Authority	Hill	18,336	18,336

1 Texas Water Development Board, "Water for Texas, Today and Tomorrow", December 1990.
2 HDR Engineering, Inc., Water Rights Analysis Package (WRAP) Model for Brazos River Basin, December 1999.
3 Brazos River Authority, Firm Yield of Brazos River Authority System for SB1, May 1999.
4 Lake Aquilla's projected firm yield for 2050 is based on the sedimentation rate experienced over a recent short-term period. Sedimentation of Lake Aquilla is being monitored by BRA and potential solutions are being evaluated.
5 HDR Engineering, Inc., Water Rights Analysis Package (WRAP) Model for Brazos River Basin, December 1999. Firm yield based on minimum annual supply from Brazos River.
6 Texas Water Development Board, "Water for Texas", August 1997.
7 Steam-electric reservoir has no firm yield.
8 Texas Water Development Board, "Water for Texas", August 1997.
9 Freese & Nichols Study prepared for West Central Texas MWD's Drought Contingency Plan, 1999.
10 HDR Engineering, Inc., "Yield Studies of Lake Palo Pinto and Turkey Peak Reservoir Site", March 1986.
11 HDR Engineering, Inc., "Reservoir Operation Studies for Proposed Lake Bosque Project and Lake Waco Enlargement", June 1985.
12 Freese & Nichols, Inc., Cleburne Long Range Water Supply Planning Study, 1996.
13 Freese & Nichols, Inc., City of Stamford, 2000.

Table 3-7.
Summary of Water Availability for Municipal Run-of-the-River and Small Reservoir Water Rights

County	Water Right Owner	Authorized Annual Diversion (acft)	Minimum Annual Supply (acft)	Year of Priority Date
Bell	City of Temple	15,804	8,418	1915
Bosque	City of Clifton	2,604	1,523	1963, 1996
Callahan	City of Baird	550	0	1949
Comanche	ERW Inc et al	200	200	1925
Eastland	Eastland Co. WSD	450	450	1919
Eastland	City of Cisco	1,000	0	1954
Erath	Tarrant Investment	60	0	1973
Erath	Thurber Lake Resort	20	0	1973
Falls	City of Marlin	1,500	1,500	1948
Falls	City of Marlin	3,500	3,500	1956
Falls	City of Rosebud	224	64	1961
Hamilton	City of Hamilton	614	614	1923
Hood	H D Howard	35	0	1976
Johnson	City of Cleburne	720	0	1985
Jones	City of Abilene	3,000	0	1954, 1955
Jones	City of Hamlin	300	0	1939
Jones	City of Anson	542	0	1950
Knox	City of Benjamin	34	34	1929
Lampasas	City of Lampasas	3,760	1,692	1914
Limestone	City of Groesbeck	2,500	152	1921
McLennan	City of Waco	5,600	5,600	1914
McLennan	City of Crawford	55	55	1983
McLennan	City of Mart	500	500	1985
McLennan	City of Robinson	13,100	5,895	1986
Milam	City of Cameron	2,792	2,792	1914
Milam	City of Thorndale	60	60	1961
Milam	City of Thorndale	100	100	1966
Milam	City of Thorndale	150	112	1982
Nolan	City of Sweetwater	2,000	116	1914
Palo Pinto	City of Graford	5	5	1932
Palo Pinto	City of Graford	50	50	1957
Palo Pinto	City of Strawn	160	160	1937
Palo Pinto	City of Gordon	115	0	1973
Palo Pinto	City of Gordon	245	0	1991
Palo Pinto	City of Gordon	45	0	1978
Shackelford	City of Moran	90	90	1923
Shackelford	City of Albany	600	600	1941
Shackelford	Marshall R. Young	21	21	1926
Throckmorton	City of Throckmorton	600	0	1940
Throckmorton	City of Woodson	60	0	1963
Young	City of Newcastle	250	0	1966

Table 3-8.
Summary of Water Availability for Industrial
Run-of-the-River and Small Reservoir Water Rights

County	Water Right Owner	Authorized Annual Diversion (acft)	75% Reliability Annual Supply (acft)	Minimum Annual Supply (acft)	Year of Priority Date
Brazos	Texas A&M University	420	420	0	1970
Comanche	Belve Bean	11	11	11	1961
Eastland	Fred Hagaman et al	100	100	0	1926
Eastland	City of Eastland	50	50	50	1919
Eastland	City of Cisco	56	12	0	1986
Eastland	Eastland Co. WSD	350	0	0	1986
Falls	City of Marlin	2,000	2,000	920	1956
Fisher	Bruce & Patsy Cox	26	0	0	1966
Grimes	Texas Municipal Power	6,000	6,000	275	1980
Grimes	Texas Municipal Power	200	200	0	1982
Grimes	Texas Municipal Power	100	100	0	1993
Grimes	Texas Municipal Power	10	10	0	1993
Hamilton	Seth Moore	2	2	2	1944
Jones	Nelson Pruett	7	7	0	1948
Lampasas	Ray A. Jones	48	48	23	1914
Milam	Joe Glaser	100	100	0	1976
Nolan	H&H Feedlot	45	29	0	1958
Palo Pinto	J&J Moore	12	12	0	1972
Robertson	Texas New Mexico Power Co.	131	131	80	1987
Robertson	Texas New Mexico Power Co.	327	327	0	1989
Shackelford	Dawson Oil	50	50	50	1925
Stephens	Breckenridge Gasoline	97	97	59	1926
Taylor	Billy Jay et al	241	241	241	1964
Taylor	West Texas Utilities	360	139	119	1967
Taylor	West Texas Utilities	2,500	2,500	2,500	1928
Washington	Waldo Neinstedt	20	0	0	1981
Williamson	A C Stearns Estate	203	203	126	1945
Young	Wilkinson	27	0	0	1966
Young	Crow et al	76	0	0	1967
Young	Crow et al	6	0	0	1977
Young	Parker & Parslety	376	0	0	1987

Table 3-9.
Summary of Water Availability by County for Irrigation
Run-of-the-River and Small Reservoir Water Rights

County	Authorized Annual Diversion (acft)	75% Reliability Annual Supply (acft)	Minimum Annual Supply (acft)
Bell	4,798	4,332	837
Bosque	9,367	7,879	3,823
Brazos	12,862	12,862	661
Burleson	5,580	5,580	375
Callahan	90	35	0
Comanche	14,258	4,932	2,224
Coryell	2,064	1,066	676
Eastland	2,545	806	602
Erath	6,138	3,881	640
Falls	9,532	9,532	1,550
Fisher	841	526	94
Grimes	1,471	1,471	103
Hamilton	3,774	1,396	609
Haskell	1,316	80	0
Hill	1,348	1,348	184
Hood	4,284	3,718	757
Johnson	247	247	0
Jones	6,425	601	222
Kent	554	0	0
Knox	2,213	2,064	7
Lampasas	1,743	1,351	390
Lee	96	11	20
Limestone	13	13	6
McLennan	7,362	6,812	2,193
Milam	8,444	8,188	1,717
Nolan	90	90	40
Palo Pinto	3,662	2,799	1,935
Robertson	15,296	15,296	1,678
Shackelford	168	31	0
Somervell	1,146	765	175
Stephens	1,172	134	116
Stonewall	8	8	0
Taylor	288	88	0
Throckmorton	9	9	0
Washington	2	0	0
Williamson	1,451	942	161
Young	1,268	143	60

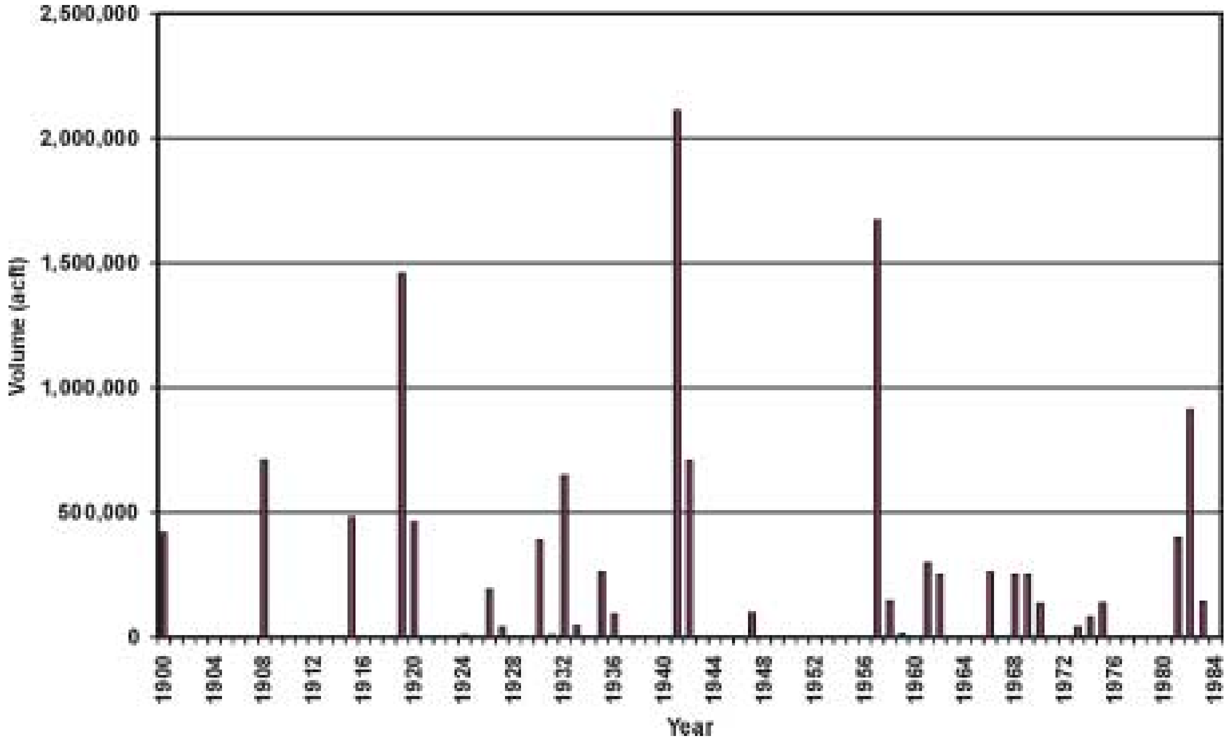

Figure 3-9. Estimate of Unappropriated Flow at South Bend Gage

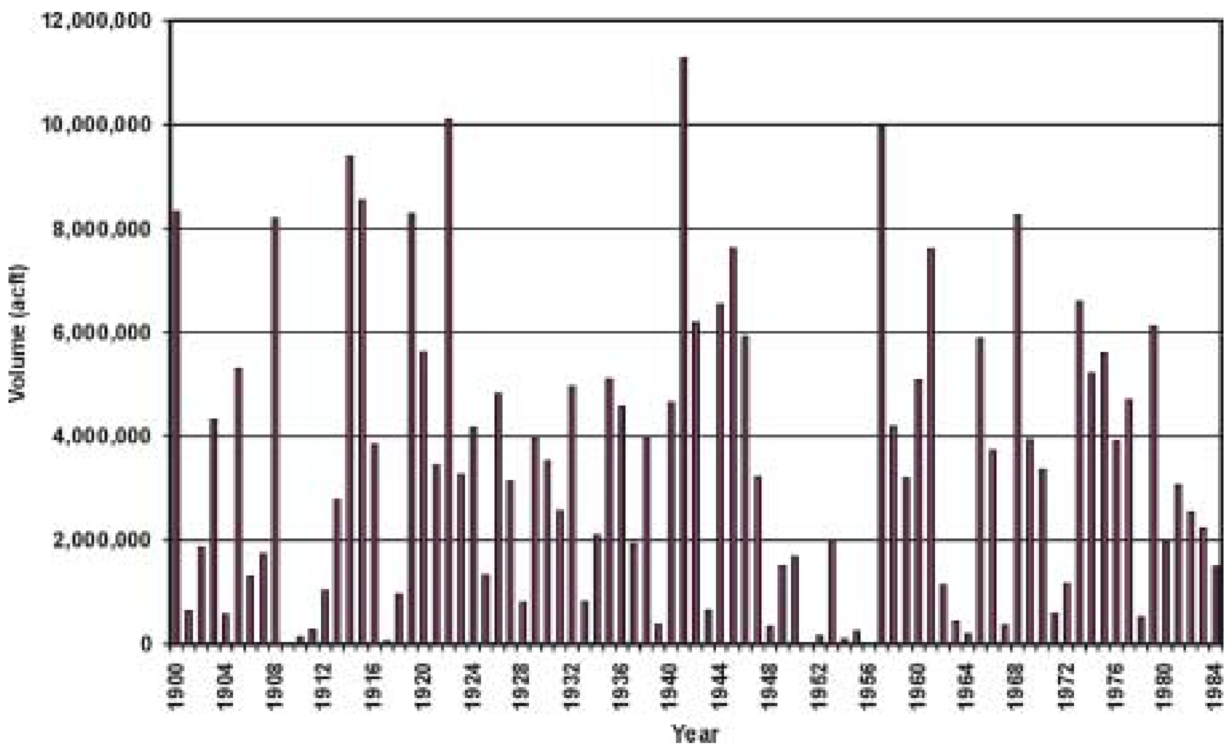

Figure 3-10. Estimate of Unappropriated Flow at Richmond Gage

during the drought years. Conversely, unappropriated flow is potentially available in most years at the Richmond gage at the lower end of the river basin and in large quantities. Unappropriated flow is not available at the Richmond gage during the severe drought year of 1951, which is the lowest flow year during the 1900 to 1984 period. Table 3-10 provides a summary of unappropriated flow potentially available at each WRAP Model control point. The results are presented as average availability for the overall period (1900-84) and drought period of 1947 to 1956. Detailed annual unappropriated flow estimates are provided in Appendix G.9.

Table 3-10.
Summary of Unappropriated Flow at WRAP Model Control Points

Control Point	Unappropriated Flow Estimate (acft/yr) Average (1900 to 1984)	Unappropriated Flow Estimate (acft/yr) Drought Average (1947 to 1956)
Lake Hubbard	4,529	0
South Bend Gage	154,146	9,786
Possum Kingdom	169,220	9,786
Lake Granbury	295,541	36,372
Lake Whitney	462,620	50,420
Lake Aquilla	52,455	8,709
Lake Waco	195,286	24,872
Lake Proctor	47,608	608
Lake Belton	245,754	18,175
Lake Stillhouse Hollow	123,054	10,650
Lake Georgetown	44,410	7,723
Lake Granger	135,248	27,848
Cameron Gage	899,333	167,689
Bryan Gage	2,250,310	490,528
Lake Somerville	155,828	43,026
Lake Limestone	120,392	24,142
Hempstead Gage	3,217,166	909,490
Richmond Gage	3,446,573	924,288

3.4 Water Quality

The Brazos River Basin WRAP Model addresses the quantity of water available for existing water rights. However, water quality issues for some sources of water for existing water rights and contracts may limit the availability of water for certain beneficial uses. The principal water quality issue in the Brazos River Basin is generally associated with total dissolved solids (TDS) and chloride (Cl) concentrations on the main stem of the Brazos River. Water sources with TDS and Cl concentrations exceeding TNRCC Drinking Water Standards of 1,000 mg/l and 300 mg/l, respectively, are generally considered as low quality and may require higher cost advanced treatment methods for use as a municipal or industrial supply.

Stream segments in the Brazos River Basin that have low quality water and water rights that divert water from these segments were identified. The stream segments were identified using water quality data available from the TNRCC and U.S Geological Survey (USGS). On the main stem of the Brazos, the Texas Water Quality Inventory Data (1996) indicated that the segment downstream of Lake Whitney to the Navasota River has low quality water. However, long-term data (Table 4.5-1) shows that good water quality in the mainstem of the Brazos River begins downstream of Lake Whitney. A review of USGS data at the Highbank stream gaging station in Falls County indicates that the concentrations of TDS and Cl are better than TNRCC Drinking Water Standards, therefore, the stream segment below the Highbank gage was not included as a low quality segment. A summary of the stream segments that have high TDS and/or Cl concentrations are summarized in Table 3-11 and shown in Figure 3-11.

Water rights that exist in stream segments with high concentrations of TDS and/or Cl are summarized in Table 3-12. The largest impacts in terms of quantity of supply are associated with Lake Possum Kingdom, Lake Granbury, and Lake Whitney. These reservoirs have a combined 2050 firm yield of 333,414 acft/yr. Advanced treatment is being utilized by some of the water right and contract holders that divert water directly from these reservoirs in order to meet drinking water standards. Other contract holders divert stored water released from these reservoirs at locations farther downstream at which point the water quality is improved as it blends with downstream tributary streamflow. Table 3-12 summarizes those water rights and water supply contracts that were found to be potentially impacted by low quality water sources.

Table 3-11.
Summary of Stream Segments with
High Chloride and Total Dissolved Solids Concentrations

Segment No.	Segment Name	Texas Water Quality Inventory - 1996 Data						Texas Water Quality Standard	
		Chloride (mg/l)			TDS (mg/l)			Chloride	TDS
		Min	Avg	Max	Min	Avg	Max	(mg/l)	(mg/l)
1203	Lake Whitney	260	336	490	901	1,103	1,528	670	1,500
1204	Brazos River below Lake Granbury	240	395	493	861	1,259	1,508	750	1,600
1205	Lake Granbury	220	406	630	1,112	1,365	1,534	1,000	2,500
1206	Brazos R. below Possum Kingdom	154	481	760	335	1,505	2,041	1,020	2,300
1207	Possum Kingdom Lake	234	574	850	869	1,455	2,047	1,200	3,500
1208	Brazos R. above Possum Kingdom	130	1,892	5,300	611	3,510	5,900	5,000	12,000
1217	Lampasas R. above Stillhouse Hollow	38	101	219	298	445	679	480	840
1223	Leon River below Lake Leon	86	286	560	121	418	898	480	1,240
1232	Clear Fork Brazos River	38	587	1,230	988	2,394	4,020	1,250	4,900
1233	Hubbard Creek Reservoir	177	258	450	590	625	735	350	750
1235	Lake Stamford	121	237	600	98	959	2,250	580	2,100
1238	Salt Fork Brazos River	5,900	17,598	37,000	1,729	31,385	65,700	23,000	40,000
1241	Double Mountain Fork Brazos River	100	1,053	2,500	630	3,980	9,920	2,500	5,500
1242	Brazos River below Lake Whitney	18	225	390	203	686	1,152	450	1,400
1253	Navasota River below Lake Mexia	80	158	246	375	659	862	440	1,350

3.4.1 Point and Nonpoint Source Pollution Water Quality

A number of stream segments and lakes in Brazos G Regional Water Planning Area do not meet water quality standards due to point and/or nonpoint source pollution. Water quality that does not meet designated uses, such as public water supply, contact recreation, and aquatic life support is very important to water supply considerations. The Texas Natural Resource Conservation Commission (TNRCC) and the U.S. Environmental Protection Agency (EPA) (40 CFR 130.7) have the responsibility to identify water bodies that do not meet, or are not expected to meet, applicable water quality standards for designated uses.[1] These stream segments and

[1] Texas Natural Resource Conservation Commission, *TMDL Guidance Document Outline*. TNRCC Web Site, http://www.tnrcc.state.tx.us

lakes are on the Clean Water Act, Section 303(d) list as impaired or threatened water bodies.[2] The summary of these segments is contained in Table 3-12.[3] The TNRCC has the responsibility to identify and prioritize water bodies that may require a Total Maximum Daily Load (TMDL) allocation to address the cause and source of a water quality impairment. Overall priorities of "high" were assigned to Aquilla Reservoir for atrazine in finished drinking water, and to the Bosque River and North Bosque River for high nutrient loading and other pollutants. A TMDL for Aquilla Reservoir has been initiated. As of August 31, 2000 TNRCC was developing a TMDL for the Bosque River and North Bosque River, including tributaries.

These water quality issues are beyond the scope of Senate Bill 1 regional water planning activities. The Brazos G Regional Water Planning Group encourages TNRCC and EPA to take responsibility and aggressively pursue their obligation to restore water quality to meet intended uses.

Table 3-12.
DRAFT Texas 2000 Clean Water Act Section 303(d) List (August 31, 2000)
Brazos G Regional Water Planning Area

Segment Number	Segment Name	Overall Priority	Source	Parameter of Concern	Segment Summary
1209A	Bryan Municipal Lake (Brazos County)	M	Point	Toxicity in ambient sediment, arsenic in water	Significant effects in ambient sediment toxicity tests sometimes occur, indicating that conditions are not optimum for aquatic life (L/NS). The average arsenic concentration in water exceeds the human health criterion for water and fish (M/NS).
1209B	Fin Feather Lake (Brazos County)	M	Point	Toxicity in ambient sediment, arsenic in water	Significant effects in ambient sediment toxicity tests sometimes occur, indicating that conditions are not optimum for aquatic life (L/NS). The average arsenic concentration in water exceeds the human health criterion for water and fish (M/NS).
1209C	Carters Creek (Brazos County)	L	Point and Nonpoint	Pathogens	Bacteria levels sometimes exceed the criterion to assure the safety of contact recreation (L/NS).
1209D	Unnamed tributary to Bryan Municipal Lake (Brazos County)	M	Point	Arsenic in water	The average arsenic concentration in water exceeds the human health criterion for water and fish (M/NS).
1210	Lake Mexia	L	Nonpoint	Depressed dissolved oxygen	Dissolved oxygen concentrations are sometimes lower that the criterion to assure optimum conditions for aquatic life (L/NS).
1213	Little River	T-m	Nonpoint	Atrazine in finished drinking water	All water quality measurements support use as a public water supply; however, atrazine concentrations in finished drinking water indicate contamination of source water and represent a threat to future use (T-m).

[2] Texas Natural Resource Conservation Commission, *State of Texas 1999 Clean Water Act Section 303(d) List and Schedule for Development of Total Maximum Daily Loads*. SFR-58/99, April 1, 1999.
[3] Texas Natural Resource Conservation Commission, *DRAFT Texas 2000 Clean Water Act Section 303(d) List (August 31, 2000)*. TNRCC Web Site, http://www.tnrcc.state.tx.us.

Table 3-12 (Continued)

Segment Number	Segment Name	Overall Priority	Source	Parameter of Concern	Segment Summary
1214	San Gabriel River	L	Point	Chloride	The average chloride concentration exceeds the criteria established to safeguard general water quality uses (L/CN).
1218	Nolan Creek South Nolan Creek	M	Point	Pathogens	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (M/NS).
1221	Leon River below Proctor Lake	M	Nonpoint	Pathogens, total dissolved solids	In 125 miles downstream of the South Fork Leon River, bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (M/NS). The average concentration of dissolved solids exceeds the criterion established to safeguard general water quality uses (L/CN).
1222	Proctor Lake	L	Nonpoint	Depressed dissolved oxygen	Dissolved oxygen concentrations are occasionally lower than the criterion established to assure optimum conditions for aquatic life (L/PS).
1222A	Duncan Creek (Comanche County)	L	Nonpoint	Depressed dissolved oxygen, pathogens	Dissolved oxygen concentrations are occasionally lower than the criterion established to assure optimum conditions for aquatic life (L/NS). Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS).
1226	North Bosque River	H	Point and Nonpoint	Pathogens, chlorophyll α	In 75 miles of the segment from the upper segment boundary downstream through the City of Clifton, bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS). According to water quality data contributed by the Texas Institute for Applied Environmental Research, elevated levels of chlorophyll α occur throughout the segment at frequencies great enough to cause a concern (H/NS). TIAER data also indicate that excessive nutrient levels are entering the segment from tributary watersheds.
1226A	Duffau Creek (Erath and Bosque Counties)	L	Nonpoint	Pathogens	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS).
1226B	Meridian Creek (Bosque County)	L	Nonpoint	Pathogens	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS).
1226D	Neils Creek	L	Nonpoint	Pathogens	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS).
1229	Paluxy River/ North Paluxy River	L	Nonpoint	Total dissolved solids	The average concentration of total dissolved solids exceeds the criterion established to safeguard general water quality uses (L/CN).
1233	Hubbard Creek Reservoir	M	Nonpoint	Sulfate	The average concentration of sulfate exceeds the criterion established to safeguard general water quality uses (M/CN).
1242	Brazos River below Whitney Lake	M	Nonpoint	Pathogens	In the Lake Brazos area near the City of Waco, bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (M/NS).
1243	Salado Creek	L	Nonpoint	Depressed dissolved oxygen, total dissolved solids	From FM 2268 downstream to the end of the segment, dissolved oxygen concentrations are occasionally lower than the criterion established to assure optimum conditions for aquatic life (L/PS). In the same portion of the segment, the concentration of total dissolved solids exceeds the criterion established to safeguard general water quality uses (L/CN).

Table 3-12 (Continued)

Segment Number	*Segment Name*	*Overall Priority*	*Source*	*Parameter of Concern*	*Segment Summary*
1244	Brushy Creek	M	Point	Total dissolved solids	The average concentration of total dissolved solids exceeds the criterion established to safeguard general water quality uses (M/CN).
1245	Upper Oyster Creek	M	Point, Nonpoint	Depressed dissolved oxygen, pathogens	Dissolved oxygen concentrations are occasionally lower than the criterion established to assure optimum conditions for aquatic life (M/PS). Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (M/NS).
1254	Aquilla Reservoir	H	Nonpoint	Atrazine and alachlor in finished drinking water, depressed dissolved oxygen	The average concentrations of atrazine in finished drinking water exceeds the maximum contaminant level for primary drinking water standards (H/NS). Contamination is present in untreated reservoir (source) water, and represents a failure of the water body to support the public water supply use. Alachlor concentrations in finished drinking water indicate contamination of source water and represent a threat to future use (T-m). Dissolved oxygen concentrations are occasionally lower than the criterion established to assure optimum conditions for aquatic life (L/PS).
1255	Upper North Bosque River	H	Point and Nonpoint	Pathogens, chloride, sulfate, total dissolved solids, ammonia nitrogen, nitrite+nitrate nitrogen, chlorophyll α, orthophosphorus, and total phosphorus	Bacteria levels sometimes exceed the criterion established to assure the safety of contact recreation (L/NS). Average chloride, sulfate, and total dissolved solid concentrations exceed the criteria established to safeguard general water quality uses (L/CN). According to water quality data contributed by the Texas Institute for Applied Environmental Research (TIAER), elevated levels of ammonia nitrogen, nitrite+nitrate nitrogen, chlorophyll α, orthophosphorus, and total phosphorus occur from the city of Stephenville downstream to the end of the segment at frequencies great enough to cause a concern (H/NS). TIAER data also indicate that excessive nutrients are entering the segment from tributary watersheds and that small reservoirs (PL-566 structures) in the watershed exceed screening criteria for phosphorus and chlorophyll α.

Explanation of Column Headings:

Segment Number:	This is the classified segment number to a water body or a portion of a water body in the Texas Surface Water Quality Standards. A letter designation following the segment number indicates an unclassified water body that is located within the watershed of the classified segment whose number is shown before the letter.
Segment Name:	The name of the water body.
Overall Priority:	The overall priority rank of the water body for TMDL development is shown in this column. If there are multiple impairments, the highest rank assigned for an individual becomes the overall rank. Impaired waters: H = high, M = medium, L= low Threatened waters: T-h = threatened-high, T-m = threatened-medium
Parameters of Concern:	Those pollutants or water quality conditions for which screening procedures indicate an existing impairment, or a threat of within the next two years.
Segment Summary:	The priority level for each pollutant is shown in parentheses, as in the overall priority column. Following the priority level will be the designation “NS” for water bodies that are not supporting their uses as designated in the Texas Surface Water Quality Standards, or the designation “PS” for water bodies that are partially supporting their designated uses. For water bodies listed for nonattainment or partial attainment of numeric or narrative criteria designed to support general water quality, the designation “CN” for criteria not supported, or “CP” for criterial partially supported, will follow the priority ranking.

3.5 Groundwater Availability

Fifteen aquifers underlie parts of the Brazos G planning region, including six of the major and nine of the minor aquifers in Texas.[4] As presented earlier, Figures 1-9 and 1-10 show locations of the major and minor aquifers. A description of each aquifer, including groundwater availability, is presented in Appendix A. Table 3-14 summarizes groundwater availability by aquifer and by area. Table 3-15 is a compilation of groundwater availability by county. The availability estimates do not include saline water (greater than 1,000 milligrams per liter of total dissolved solids) and assumes a uniform distribution of withdrawals.

[4] Texas Water Development Board, *Water for Texas*, 1997

Table 3-13. Municipal Surface Water Supply Potentially Impacted by High TDS and Chloride Concentrations

Segment No.	Description	Water Right or Contract Owner	Water Right No	Permitted Diversion (acft/yr)	Contract Amount (acft/yr)	County of Use
1203	Lake Whitney	Brazos River Authority	5157	18,336		
		City of Cleburne			4,700	Johnson
		City of Whitney			750	Hill
		Fred T. Owen, Jr.			60	Hill
		Lakeside Domestic Use			20	
		TOTAL		18,336	5,530	
1205	Lake Granbury	Brazos River Authority	5156	64,712		
		Acton MUD[1]			3,000	Hood
		City of Granbury[1]			7,121	Hood
		Johnson Co. FWSD No. 1[1]			2,665	Johnson
		Johnson Co. Rural WSC[1]			5,944	Johnson
		City of Godley			95	Johnson
		City of Rio Vista			65	Johnson
		Southwest Water Service, Inc. [1]			300	Hood
		Lakeside Domestic Use			150	Hood
		TOTAL		64,712	19,340	
1207	Possum Kingdom	Brazos River Authority	5155	230,750		
		City of Graham			1,000	Young
		City of Granbury[1]			6,679	Hood
		City of Lorena			1,000	McLennan
		City of Marlin			1,200	Falls
		City of Rosebud			100	Falls
		Double Diamond			1,000	Palo Pinto
		Fossen, Ford & Fossen			10	Palo Pinto
		Jowell Bailey			6	Palo Pinto
		Lakeside Domestic Use			375	Palo Pinto
		Mr. Leo H. Cook			5	Palo Pinto
		Pickwick Association, Inc.			20	Palo Pinto
		Sportsman's World MUD[2]			125	Palo Pinto
		Wanda Marquis			5	Palo Pinto
		West Side Water Group			5	Palo Pinto
		Acton MUD[1]			7,800	Hood
		Texas Parks & Wildlife Dept.			800	Palo Pinto
		TOTAL		230,750	21,401	
1223	Leon River	Eastland Co. WSD	3470	5,450		
		Various Users – Eastland Co.			450	
		TOTAL		5,450	450	
1235	Lake Stamford	City of Stamford	4179	10,000		
		City of Stamford			556	Jones
		City of Stamford			11	Haskell
		City of Hamlin			1,120	Jones
		City of Lueders			51	Jones
		City of Lueders			1	Shackelford
		Ericksdahl WSC			31	Jones
		Ericksdahl WSC			4	Shackelford
		Ericksdahl WSC			2	Haskell
		Paint Creek WSC			87	Haskell
		Paint Creek WSC			5	Jones
		Sagerton WSC			73	Haskell
		TOTAL		10,000	1,941	
1253	Brazos River below Lake Whitney	City of Robinson	5085	13,100		McLennan
		City of Waco	4340	5,600		McLennan
1253	Navasota River below Lake Mexia	Bistone WSC	5287	3,000		Limestone
		City of Groesbeck	5289	2,500		Limestone

[1] Utilizing advanced treatment (desalination) at Lake Granbury.
[2] Utilizing advanced treatment (desalination).

Table 3-14.
Groundwater Availability from BGRWPA Aquifers

Aquifer	*2050 Availability (acft/yr)*	*Typical Range in Well Yields (gpm)*
Western Area		
Seymour	69,893	100 to 1,000
Dockum	3,484	100 to 400
Blaine	1,333	less than 25
Edwards-Trinity (Plateau)	800	5 to 300
Subtotal:	75,510	
Central Area		
Trinity	77,563	50 to 500
Edwards (BFZ)	5,000	200 to 2,000
Woodbine	2,432	50 to 150
Marble Falls	4,183	less than 100
Ellenburger-San Saba	551	
Hickory	NA	NA
Subtotal:	89,729	
Southeastern Area		
Brazos River Alluvium	66,700	250 to 500
Carrizo-Wilcox	280,936	100 to 3,000
Queen City	3,459	200 to 500
Sparta	10,333	200 to 600
Gulf Coast	28,296	300 to 800
Subtotal:	389,724	
Other and Undifferentiated	2,915	—
Total:	557,878	

NA indicates not determined.

The distribution of groundwater availability is summarized by dividing the BGRWPA into three areas. As tabulated in Table 3-14 and shown in Figure 3-12, the groundwater is poorly divided with about 14 percent occurring in the western area, about 16 percent in the central area, and about 70 percent of in the eastern area.

3.5.1 Western Area

In the western area only part of the area is underlain by a major or minor aquifer, as shown in Figures 1-9 and 1-10. Together, the four aquifers (Blain, Dockum, Edwards-Trinity (Plateau), and Seymour) can supply up to 75,510 acft/yr. Of the four aquifers, the Seymour Aquifer has nearly 93 percent of the supplies and is scattered in six counties; however, about

Table 3-15.
Groundwater Availability in BGRWPA Counties and Aquifers

County	Aquifer	Availability (acft/yr)
Bell	Edwards-BFZ(Austin)	1,315
	Trinity	2,169
	Subtotal:	3,484
Bosque	Brazos River Alluvium	2,500
	Trinity	1,718
	Subtotal:	4,218
Brazos	Brazos River Alluvium	12,500
	Carrizo-Wilcox	46,458
	Gulf Coast	1,177
	Queen City	645
	Sparta	2,107
	Subtotal:	62,887
Burleson	Brazos River Alluvium	9,400
	Carrizo-Wilcox	46,458
	Queen City	672
	Sparta	1,666
	Subtotal:	58,196
Callahan	Trinity	3,787
	Subtotal:	3,787
Comanche	Trinity	21,976
	Subtotal:	21,976
Coryell	Trinity	1,791
	Subtotal:	1,791
Eastland	Trinity	4,853
	Subtotal:	4,853
Erath	Trinity	20,165
	Subtotal:	20,165
Falls	Brazos River Alluvium	15,600
	Carrizo-Wilcox	4,406
	Trinity	161
	Subtotal:	20,167
Fisher	Dockum	102
	Seymour	7,010
	Subtotal:	7,112
Grimes	Brazos River Alluvium	1,700
	Carrizo-Wilcox	6,789
	Gulf Coast	14,083
	Queen City	462
	Sparta	2,044
	Subtotal:	25,078

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Table 3-15 (continued)

County	Aquifer	Availability (acft/yr)
Hamilton	Trinity	2,146
	Subtotal:	2,146
Haskell	Seymour	22,866
	Subtotal:	22,866
Hill	Trinity	2,383
	Woodbine	1,433
	Subtotal:	3,816
Hood	Trinity	6,163
	Subtotal:	6,163
Johnson	Trinity	2,053
	Woodbine	866
	Subtotal:	2,919
Jones	Seymour	7,950
	Subtotal:	7,950
Kent	Dockum	102
	Seymour	5,668
	Subtotal:	5,770
Knox	Blaine	1,333
	Seymour	24,134
	Subtotal:	25,467
Lampasas	Ellenburger-San Saba	551
	Marble Falls	4,183
	Trinity	2,145
	Subtotal:	6,879
Lee	Carrizo-Wilcox	46,458
	Queen City	1,240
	Sparta	3,900
	Subtotal:	51,598
Limestone	Carrizo-Wilcox	37,451
	Trinity	66
	Woodbine	33
	Subtotal:	37,550
McLennan	Brazos River Alluvium	15,600
	Trinity	1,718
	Woodbine	100
	Subtotal:	17,418

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Table 3-15 (concluded)

County	Aquifer	Availability (acft/yr)
Milam	Carrizo-Wilcox	46,458
	Trinity	321
	Subtotal:	46,779
Nolan	Dockum	3,280
	Edwards-Trinity (Plateau)	600
	Subtotal:	3,880
Palo Pinto	Trinity	286
	Subtotal:	286
Robertson	Brazos River Alluvium	6,300
	Carrizo-Wilcox	46,458
	Queen City	440
	Sparta	616
	Subtotal:	53,814
Shackelford		0
	Subtotal:	0
Somervell	Trinity	1,233
	Subtotal:	1,233
Stephens	Other Aquifer	705
	Subtotal:	705
Stonewall	Seymour	2,265
	Subtotal:	2,265
Taylor	Edwards-Trinity (Plateau)	200
	Trinity	679
	Subtotal:	879
Throckmorton	Other Aquifer	364
	Subtotal:	364
Washington	Brazos River Alluvium	3,100
	Gulf Coast	13,036
	Subtotal:	16,136
Williamson	Edwards-BFZ(Austin)	3,685
	Trinity	1,750
	Other Aquifer	665
	Subtotal:	5,935
Young	Other Aquifer	1,181
	Subtotal:	1,181
Total:		557,878

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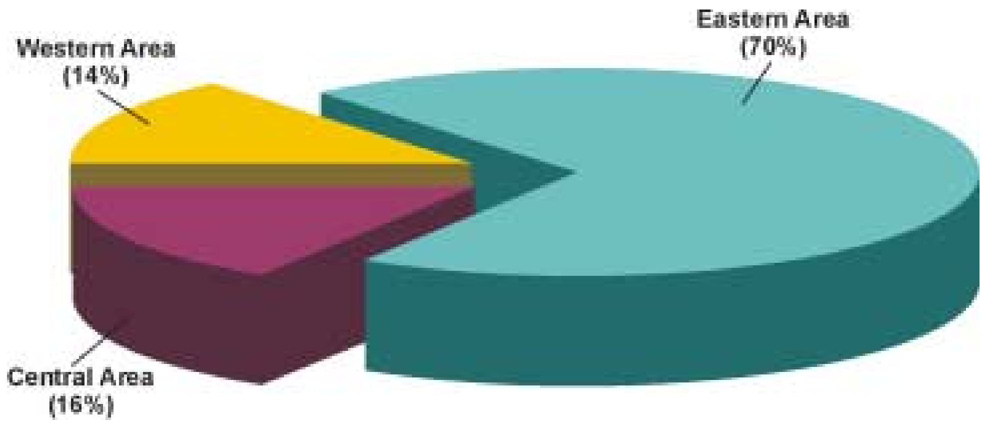

Figure 3-12. Distribution of Groundwater by Area — 554,963 acft/yr

67 percent of the supply is in Knox and Haskell Counties (Figure 3-13). The Dockum Aquifer exists only on the western fringe and has less than 5 percent of the groundwater supply in the area. Undifferentiated aquifers underlie some of the area, including all of Shackelford, Stephens, Throckmorton, and Young Counties. At best, the undifferentiated aquifers can provide only meager supplies for livestock and domestic uses.

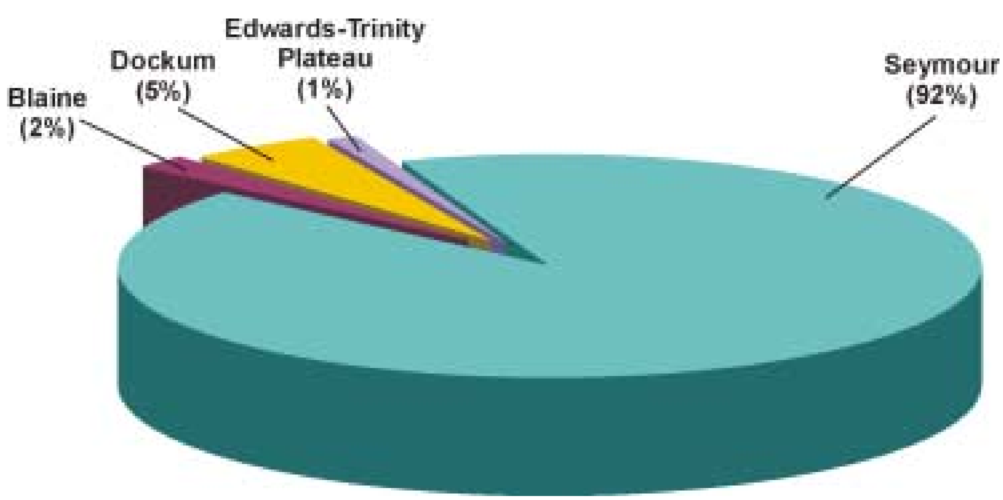

Figure 3-13. Groundwater Availability in the Western Area — 75,510 acft/yr

3.5.2 Central Area

In the central area, major or minor aquifers exist in the southeastern two-thirds of the area, as shown in Figures 1-9 and 1-10. Together, the five aquifers (Edwards-Balcones Fault Zone-Austin, Ellenburger-San Saba, Marble Falls, Trinity, and Woodbine) can provide up to 89,729 acft/yr. Of the five aquifers, the Trinity Aquifer is most extensive and has about 86 percent of the supplies (Figure 3-14). Although the Trinity Aquifer as a whole can provide 77,563 acft/yr, local areas have been severely over-drafted and cannot yield substantial supplies in the current planning period. None of the other aquifers can provide more than 5 percent of the groundwater supply in the area.

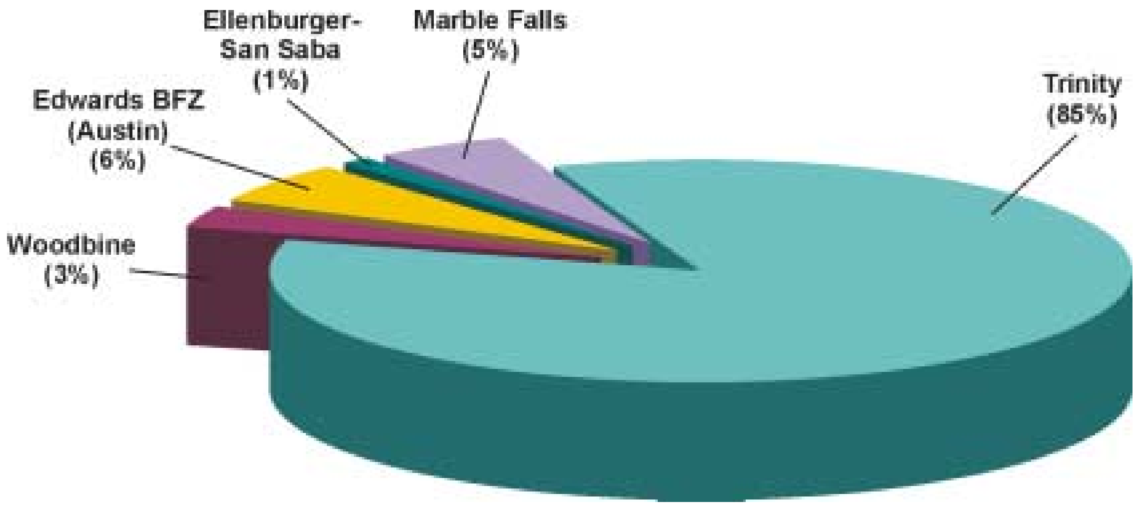

Figure 3-14. Groundwater Availability in the Central Area — 89,729 acft/yr

3.5.3 Eastern Area

In the eastern area, major or minor aquifers exist throughout the area except in the western fringe, as shown in Figures 1-9 and 1-10. Together, the five aquifers (Brazos River Alluvium, Carrizo-Wilcox, Gulf Coast, Queen City, and Sparta) can provide up to 389,724 acft/yr. Of the five aquifers, the Carrizo-Wilcox Aquifer is most extensive and has about 72 percent of the supplies (Figure 3-15). The Brazos River Alluvium has about 17 percent of the supplies.

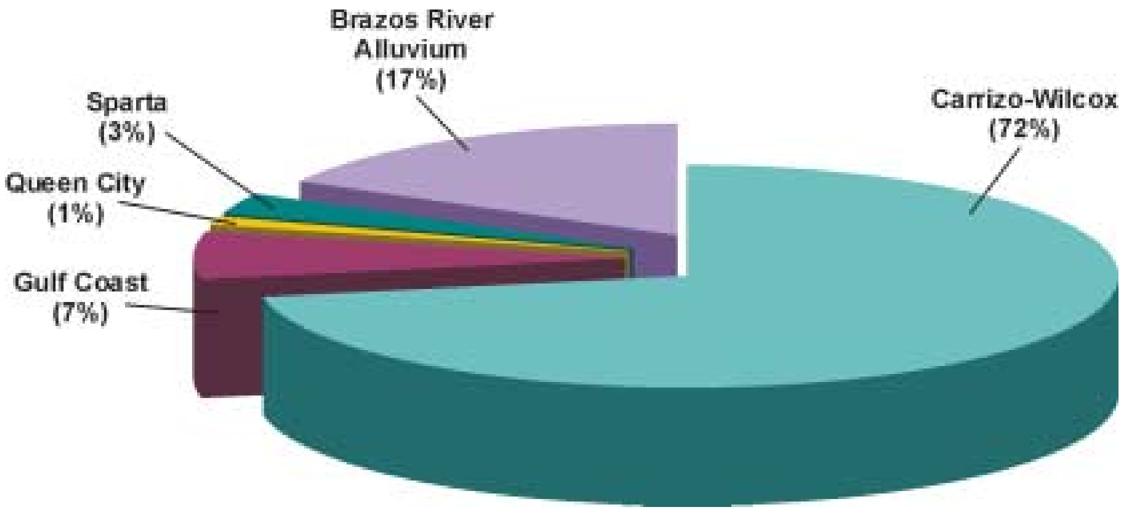

Figure 3-15. Groundwater Availability in the Eastern Area — 389,724 acft/yr

3.5.3.1 Carrizo-Wilcox Groundwater Model

The Carrizo-Wilcox Aquifer is of major significance to Brazos G regional water planning due to large, undeveloped water availability and its potential importance in meeting the Eastern Area water demands. Therefore, a groundwater computer model specific to the Brazos G portion of the Carrizo-Wilcox Aquifer was developed to verify the groundwater availability projections provided in Table 3-15. A description of the groundwater model and the simulation results are provided in a separate report.

Simulations were performed for historical and future demand projections and development alternatives contained in the Brazos G Water Plan. Simulations included withdrawals from the Carrizo-Wilcox Aquifer of about 100,000 acft/yr through 1998 and up to about 280,000 acft/yr through 2050. Based on historical withdrawals and future demand projections, the largest artesian pressure declines are going to occur in the Bryan-College Station area with a maximum artesian pressure decline of more than 400 feet over the period 1950 through 2050. To date, about 200 feet of decline has already occurred in this area. Declines of over 300 feet are anticipated in Milam and Lee Counties over the 1950 to 2050 period. Other areas in the Brazos G region are anticipated to experience lower declines primarily due to less demand. Within the Brazos G region, these declines are anticipated to be primarily in the Simsboro zone of the Carrizo-Wilcox Aquifer. Declines in other zones of the Carrizo-Wilcox

Aquifer (Carrizo, Calvert Bluff and Hooper) are anticipated to be much smaller due to less projected pumpage.

Model simulations indicate all Carrizo-Wilcox groundwater demands included in the Brazos G Water Plan can be met with significant reserves remaining well past the 50-year planning horizon. The Brazos G Carrizo-Wilcox groundwater availability projections are generally based on the 1997 *State Water Plan* (Plan) prepared by the TWDB. The model results indicate significantly more water is available than the 1997 estimates. As with any larger scale groundwater development, additional evaluations and planning are recommended such that appropriate technical, economic and environmental issues can be more fully considered.

3.5.4 Data and Information Needs

To make major improvements in the accuracy and reliability of existing groundwater availability estimates, the following data, analyses, and tools are suggested.

- Water levels measurements
    - Frequency (daily or monthly): At a relatively few and key locations, water level data for long periods of time provide documentation on trends and a means of determining if the trends can or should be modified.
    - Coverage: Infrequent (annual) water level measurements made at many locations over a relatively short period of time provides a key data element in constructing water level maps that can show the regional flow patterns and extent of influence from pumping centers.
- Recharge
    - Outcrop areas: Estimates, actually assumptions at this time, can be greatly improved by establishing a data collection network of precipitation gages and shallow water level monitoring wells in the outcrop areas.
    - Streams: Estimates can be made by conducting streamflow gain-loss studies and the establishment of monitoring networks to measure stage and discharge of stream and water levels in nearby shallow wells.
    - Cross-formational flow: These estimates would be made with existing hydrogeologic information, development of models and a rather dense network of water level monitoring wells.
- Discharge
    - Wells: The existing estimates of pumpage are believed to be rather inaccurate. In the calculation of availability, withdrawals are very strong control in aquifer conditions and directly influence the results.
    - Streams and wetlands areas: Estimates can be improved with rather dense networks of water level monitoring wells and flow-net analyses.

- Modeling: The best way in developing a water budget for an aquifer and the calculation of groundwater availability is the development of a groundwater flow model. Once the model has been tested, it is very useful in testing various groundwater development scenarios.
- Water Quality: Networks of wells and periodic sampling are needed in areas where the water is vulnerable to contamination. This is most important in outcrop areas where there is considerable activity and development.

3.6 Drought Trigger Levels

As required by SB1, each regional water plan must address drought management and for each water supply source within the region. This includes both groundwater and surface water sources. Where possible, existing drought management plans have been reviewed to develop consistent trigger conditions and management actions for each source.

For surface water sources (i.e., reservoirs), a single drought trigger was identified based on reservoir content or water surface elevation. The trigger levels for water supply reservoirs are listed in Table 3-16. For each trigger listed in Table 3-16, there is a management action associated with it that would be enacted when the trigger level is reached.

For groundwater sources, the monitoring of water levels on a regular basis provides critical data necessary to manage the water supply for municipal, industrial or irrigation demands. Historical water levels combined with water demand or pumping data allow management to establish different trigger levels for the various stages of drought. Monthly water use data would allow management to establish trigger water levels during the year and appropriate actions to take once trigger water levels are exceeded. Each user would determine the management of the water supply based on the level of drought. Specific monitoring wells for municipal supplies were not identified due to the variability of well condition, access, economics and location to pumping wells.

Table 3-17 summarizes the general recommendations of the Brazos G Regional Water Planning Group regarding the identification and initiation of drought responses to water supply sources in the Brazos G Region. As the regional planning group is a planning body only, with no implementation authority, it is emphasized that these drought responses are only recommendations. Local public and private water suppliers and water districts have been required to adopt a Drought Contingency Plan by TNRCC that contains drought triggers and

Table-3.16.
Drought Trigger Conditions by Surface Water Source

Reservoir	Trigger for Initial Drought Response[1]	Action
Lake Abilene	Water surface elevation is below 1994-ft.	Approximately 5 % of Abilene's municipal water supply is from Lake Abilene under normal conditions. In drought conditions, water from Lake Fort Phantom Hill and/or Hubbard Creek Reservoir will compensate for reduced supply from Lake Abilene.
Alcoa Lake	Steam-Electric Cooling Reservoir - No Drought Contingency Plan required	No Drought Contingency Plan required .
Lake Alan Henry	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.
Aquilla Reservoir	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.
Lake Belton	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.
Lake Cisco	Content is equal to or less than 40% of capacity.	Inform public by mail and through the news media that a trigger condition has been reached and that water users should look for ways to reduce water consumption voluntarily. Advise public of the trigger condition weekly. Request water users to insulate pipes rather than allowing water to flow to keep pipe from freezing.
Lake Daniel	Water surface elevation is at 1266 or below feet msl.	Develop a drought Information Center and designate an Information Person. Advise the public of the drought condition and publicize the availability of information from the Information Center. Encourage voluntary reduction of water use. Contact commercial users and explain the necessity for initiation of strict conservation methods. Make adjustments to the program to meet changing conditions.
Lake Fort Phantom Hill	Water surface elevation below 1624.9-ft (11-ft below spillway)	Implement Drought Contingency Plan - Water Alert – Landscape irrigation and swimming pool filling is restricted to 7-day schedule. Vehicle washing only by bucket or commercial car wash. Ornamental fountains, hard surface washing, and other "waste of water" activities are restricted.
Lake Georgetown	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.

Table-3.16 (continued)

Reservoir	***Trigger for Initial Drought Response[1]***	***Action***
Gibbons Creek Reservoir	Steam-Electric reservoir - No Drought Contingency Plan required	No action required.
Lake Graham/ Eddleman	Water surface elevation at or below 1064 feet msl.	Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses.
Lake Granbury	Total storage in all system reservoirs is at or below 75% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, water in storage could be reduced to 60% or less capacity in the next 12 months.	All currently defined system reservoirs will be reviewed for possible redefinition as local-use reservoirs. Should any reservoir be so redefined, new active water supply capacities will be evaluated. Modifying or otherwise altering maintenance and repair schedules if these are used to declare a reservoir local-use only. If the redefined active water supply capacity still falls within the range of drought declaration, a specific drought contingency plan will be developed for managing all system reservoirs to deal with the problems anticipated as a result of the declared drought condition. A drought contingency plan will consider the desirability of actions such as those listed for a local-use reservoir.
Lake Granger	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.
Hubbard Creek Reservoir	Content is below 60% capacity	Implement Drought Contingency Plan. Communicate drought conditions to the public and promote voluntary conservation. Inform users of minimum probable time interval before next drought stage.
Lake Leon	Content at or below 50% of storage capacity.	Inform all wholesale customers to initiate voluntary water restrictions and invoke stage 1 of their drought contingency plans. Reduce or discontinue flushing of water mains.
Lake Limestone	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.
Miller's Creek Reservoir	Storage is at or below 9,000 acft.	Implement Drought Contingency Plan. Achieve a voluntary 10% reduction in water use. Contact wholesale water customers to initiate voluntary measures and to discuss supply and demand conditions. Provide weekly report to news media.
Lake Palo Pinto	Water surface elevation is equal to or less than 858 feet msl.	Voluntary water conservation. Inform public by media and mail. Set up Information Center.
Pat Cleburne Reservoir	Content is equal to or less than 75% of conservation storage capacity (Lake Level 729.2 feet)	Activate the Drought Information Center and designate an Information Supervisor. Advise the public of the drought condition and publicize the availability of information from the drought Information Center. Encourage voluntary reduction of water use. Contact Commercial users and explain the necessity for initiation of strict conservation methods.

Table-3.16 (continued)

Reservoir	***Trigger for Initial Drought Response[1]***	***Action***
Possum Kingdom Reservoir	Total storage in all system reservoirs is at or below 75% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, water in storage could be reduced to 60% or less capacity in the next 12 months.	All currently defined system reservoirs will be reviewed for possible redefinition as local-use reservoirs. Should any reservoir be so redefined, new active water supply capacities will be evaluated. Modifying or otherwise altering maintenance and repair schedules if these are used to declare a reservoir local-use only. If the redefined active water supply capacity still falls within the range of drought declaration, a specific drought contingency plan will be developed for managing all system reservoirs to deal with the problems anticipated as a result of the declared drought condition. A drought contingency plan will consider the desirability of actions such as those listed for a local-use reservoir.
Lake Proctor	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.
Lake Somerville	Total storage in all system reservoirs is at or below 75% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, water in storage could be reduced to 60% or less capacity in the next 12 months.	All currently defined system reservoirs will be reviewed for possible redefinition as local-use reservoirs. Should any reservoir be so redefined, new active water supply capacities will be evaluated. Modifying or otherwise altering maintenance and repair schedules if these are used to declare a reservoir local-use only. If the redefined active water supply capacity still falls within the range of drought declaration, a specific drought contingency plan will be developed for managing all system reservoirs to deal with the problems anticipated as a result of the declared drought condition. A drought contingency plan will consider the desirability of actions such as those listed for a local-use reservoir.
Squaw Creek Reservoir	Steam-Electric Cooling Reservoir - No Drought Contingency Plan required	No Drought Contingency Plan required
Lake Stamford	Content is equal to 12,276 acft, water elevation is 12 feet below spillway	All customers are asked to curtail use of water for nonessential purposes on a voluntary basis.
Lake Stillhouse Hollow	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.
Lake Sweetwater	Content equals 20,379 acft, or water elevation is 10 feet below spillway.	All customers are asked to curtail use of water for nonessential purposes on a voluntary basis.
Tradinghouse Creek Reservoir	Steam-Electric Cooling Reservoir - No Drought Contingency Plan required	No Drought Contingency Plan required
Twin Oak Reservoir	Steam-Electric Cooling Reservoir - No Drought Contingency Plan required	No Drought Contingency Plan required
Lake Waco	Content is at or below 50% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, indicate that water in storage could be reduced to 40% or less of capacity in the next 12 months.	Implement Drought Contingency Plan. Notify all water contract holders of reservoir level. Contact and request appropriate actions of the TNRCC, USGS, Corps of Engineers, and water contract holders.

Table-3.16 (continued)

Reservoir	***Trigger for Initial Drought Response[1]***	***Action***
Lake Whitney	Total storage in all system reservoirs is at or below 75% of capacity and estimates of current annual demands coupled with inflows and evaporation representative of the drought of record, water in storage could be reduced to 60% or less capacity in the next 12 months.	All currently defined system reservoirs will be reviewed for possible redefinition as local-use reservoirs. Should any reservoir be so redefined, new active water supply capacities will be evaluated. Modifying or otherwise altering maintenance and repair schedules if these are used to declare a reservoir local-use only. If the redefined active water supply capacity still falls within the range of drought declaration, a specific drought contingency plan will be developed for managing all system reservoirs to deal with the problems anticipated as a result of the declared drought condition. A drought contingency plan will consider the desirability of actions such as those listed for a local-use reservoir.

[1]For some sources, only initial drought response trigger condition is listed (i.e., Stage 1 conditions). In some cases, entities have other trigger levels for more severe drought conditions.

responses unique to their entity. Furthermore, those entities have the authority and responsibility to manage their particular water supply within bounds created by applicable law. Accordingly, the RWPG encourages each entity to review their respective plans with due consideration of the recommendations summarized in Table 3-17.

As noted in Table 3-17, the Trinity (counties other than Callahan and Eastland Counties), Dockum, Blaine, Woodbine, Marble Falls, Ellenburger-San Saba, Hickory, Brazos River Alluvium, Carrizo-Wilcox, Queen City, Sparta, and Gulf Coast Aquifers have little or no response to transient hydrologic drought conditions because of the very large quantity of water in storage and/or relatively long distance from recharge areas. However, all the aquifers, both locally and regionally, are subject to unacceptable long-term depletion or lowering of water levels. If this occurs, there is likely to be sufficient time to develop alternative sources of supply.

As with any source of water supply, limited capacity of production, treatment and distribution facilities may necessitate expedited expansions or implementation of water conservation measures during dry periods when water demands are unusually great.

Table 3-17.
Identification and Initiation of Drought Responses for Groundwater Sources

Source of Water Supply	***Factors to be Considered in Initiating Drought Response(s)***	***Potential Drought Response***
Seymour Aquifer	• Water level in TWDB Monitoring Well 21-35-702 (Haskell County) • Trigger water level is 30 feet below measuring point • Limit of water production, treatment and distribution facility	• Evaluate local groundwater levels • Implementation of current Drought Contingency Plans • Increase reliance on alternative supplies • Reduce irrigation acreage
Edwards-Trinity (Plateau) Aquifer	• Water level in TWDB Monitoring Well 29-47-701 (Nolan County) • Trigger water level is 35 feet below measuring point • Limit of water production, treatment and distribution facility	• Evaluate local groundwater levels • Implementation of current Drought Contingency Plans • Increase reliance on alternative supplies
Trinity Aquifer (Callahan and Eastland Counties)	• Water level in TWDB Monitoring Well 31-43-702 (Eastland County) • Trigger water level is 25 feet below measuring point • Limit of water production, treatment and distribution facility	• Evaluate local groundwater levels • Implementation of current Drought Contingency Plans • Increase reliance on alternative supplies • Reduce irrigation acreage
Edwards (BFZ) Aquifer	• Water level in TWDB Monitoring Well 58-35-204 (Williamson County) • Trigger water level is 150 feet below measuring point • Limit of water production, treatment and distribution facility	• Evaluate local groundwater levels • Implementation of current Drought Contingency Plans • Increase reliance on alternative supplies
• Trinity Aquifer (Counties other than Callahan and Eastland Counties) • Dockum Aquifer • Blaine Aquifer • Woodbine Aquifer • Marble Falls Aquifer • Ellenburger-San Saba Aquifer • Hickory Aquifer • Brazos River Alluvium • Carrizo-Wilcox Aquifer • Queen City Aquifer • Sparta Aquifer • Gulf Coast Aquifer	• In most all areas, water supplies from these aquifers are not constrained by drought conditions • Unacceptable drawdown in specific well fields • Acceptable long-term drawdown of regional water levels • Limit of water production, treatment and distribution facility	• Evaluate local groundwater levels • Implementation of current Drought Contingency Plans • Increase reliance on alternative supplies • Reduce irrigation acreage

Section 4
Comparison of Water Demands with Water Supplies to Determine Needs

4.1 Introduction

In this section, the demand projections from Section 2 and the supply projections from Section 3, are brought together to estimate projected water needs in the region for the next 50 years.

As a recap, Section 2 presented demand projections for six types of use: municipal, manufacturing, steam-electric, mining, irrigation, and livestock. The projections are for dry year demands. Additionally, municipal water demand projections were shown for each city with a population of more than 500 and for the County-Other category in each county. Section 3 presented surface water and groundwater availability.

4.1.1 Methods to Estimate Water Supplies

Surface water and groundwater availability were determined among the six user groups using the methods explained below.

4.1.1.1 Surface Water Supplies

Surface water in the region available to meet projected demands consists of firm yield of reservoirs, dependable supply of run-of-river water rights through drought of record conditions, and local on-farm sources. Contracts and/or rights to reservoirs, and run-of-river rights were allocated as supplies to their stated type of use: municipal, industrial (manufacturing, steam-electric, and mining), and irrigation. Additionally, municipal supply was further allocated among cities and other municipal water supply entities. This was done by obtaining water seller information (i.e., which contract/right holders – a wholesaler – are reselling water to other water supply entities) and water purchase contract limits between buyers and sellers. This information was obtained from TWDB files and follow-up queries to water supply entities. For contracts expiring prior to 2050, the water supplies shown in Tables 4-1 through 4-74 reflect the cessation of supplies under that contract. If contract expiration date information was unavailable, it was assumed that the contract would remain in place through 2050. Please see Appendix G.5 for a summary of available surface water contract information, expiration dates, and renewal clause information. Water associated with a wholesaler that is not resold, remains as an available supply to the wholesaler in the supply tables. In the case where a wholesaler's supply is deficient to meet its own demands and contract requirements, it was assumed that contracts were met in full, and any shortage is shown in the wholesaler's projections.

As an illustration, Eastland County Water Supply District has a contract to supply 1,791 acft/yr to the City of Eastland from Lake Leon. This contract expires in 2032 and does not have a renewal clause; therefore, City of Eastland is shown with no supply in Table 4-16 after year 2032. The City of Eastland also sells water under contract to the City of Carbon and Westbound Water Supply Corporation. Neither contract has a renewal clause. The contract with the City of Carbon is for 73 acft/yr and expires in 2009; this water is shown reverting back to a supply for Eastland in Table 4-16, starting in 2010. The contract with Westbound Water Supply Corporation is for 47 acft/yr and expires in 2022. Again, this 47 acft reverts back to a supply to Eastland after 2022 until 2032, as shown in Table 4-16.

In most cases, surface water supply from stock ponds and streams was shown to be available to meet livestock needs when groundwater supplies were insufficient to meet those demands.

4.1.1.2 Groundwater Allocation

Total groundwater availability in the region was determined based on the specific methods identified for each aquifer as discussed in Appendix B. For many aquifers the availability is based on the long-term effective recharge. For other aquifers, various methods consistent with those used in the 1997 Water Plan were used. This total groundwater availability was shown for each county, by aquifer, in Table 3-14. For each county, total available groundwater was allocated among the six user groups—municipal, manufacturing, steam-electric, mining, irrigation, and livestock—in the following manner:

- Using TWDB records, user groups relying on groundwater supply were determined.
- Allocation percentages for each user group using groundwater were made based on their 1997 groundwater use.
- Allocation percentages were used to distribute sustainable groundwater pumpage estimates in each county to each user group in each county.

Groundwater distributed to municipal use was further redistributed to cities and County-Other. For each county, this was done in the following manner:

- Using TWDB records, cities and County-Other relying on groundwater supply were determined.
- Allocation percentages for each city and County-Other using groundwater were made based on 1997 groundwater use.
- Allocation percentages were used to distribute sustainable groundwater pumpage estimates to each municipality and County-Other category.

Additional minor adjustments were made to several of the cities and/or categories based upon more current information and the consultant team's local understanding of the areas involved.

Unless otherwise noted, Tables 4-1 to 4-74, reflect the above methodology.

4.1.1.3 Infrastructure Constraints

Surface water and groundwater distributed to cities and County Other in each county were also examined for infrastructure constraints. A surface water constraint and a groundwater constraint were developed for each entity.

Both groundwater and surface water infrastructure constraints were developed using information from the annual Compliance Evaluation Program conducted by TNRCC. The groundwater constraint was based upon the well pumping capacity given in the sanitary survey. This capacity was converted to acft per year. Dividing by a peaking factor of 2.0 represented the pumping capacity of the wells in terms of an average annual supply. This was then compared to the groundwater supply that had been allocated to the city. The lesser of the two supplies (i.e., groundwater supply or annual pumping capacity) was reported as the water supply for the entity. In the cases where the supply was restricted by well pumping capacity, the entity was footnoted as "infrastructure limited".

The surface water constraint was based upon three factors, raw water intake capacity, booster or pump station capacity, and pipeline capacity. The lowest capacity of the three was the controlling capacity. As in the groundwater constraint development, the controlling capacity was converted to acft per year. Dividing by a peaking factor of 2.0 represented the capacity of the surface water infrastructure in terms of an average annual supply. This was then compared to the surface water supply of the entity. The lesser of the two supplies (i.e., surface water supply or infrastructure capacity) was reported as the water supply for the entity.

For example: In Robertson County, the City of Hearne was initially allocated 2,416 acft/yr of groundwater. However, the city has a well capacity of 1,476 acft/yr, which is less than Hearne's actual availability. Consequently the City of Hearne was reported having a 1,476-acft/yr water supply (Table 4-56).

For both surface water and groundwater, the municipal supply totals in the county summary pages may be larger than the sum of municipal supplies on the city summary pages. This is because the county summary pages report total available supply, regardless of constraints, whereas the city summary pages reflect constraints.

4.2 County Summaries – Comparison of Demand to Supply

4.2.1 Comparison of Demand to Supply – Bell County

- Water demand and potential supply summary for all six use categories (Table 4-1).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-2).

Demands

- Water demand projections for 22 rural municipal water systems in Bell County were calculated to support County-Other municipal projections.
- Demands for Salado reflect the Census Designated Place (CDP) area; however, projected demands of the broader Salado WSC service area are contained in the County-Other category.
- From the year 2000 to 2050, municipal demand increases from 47,389 acft to 81,663 acft.
- Steam-electric demand of 11,200 acft is projected by the year 2010.
- For 2000 to 2050 period, projected manufacturing demand increases from 4,040 acft to 8,700 acft; projected manufacturing demand is about 8 percent of current countywide M&I use.
- Irrigation and livestock demand is small compared to county total demands, comprising only about 4 percent of all demands.

Supplies

- Surface water supply is obtained from water contracts with the Brazos River Authority for supply from Lakes Belton and Stillhouse Hollow, and from run-of-river rights on the Lampasas and Leon Rivers.
- Groundwater supplies are from the Trinity and Edwards (BFZ) aquifers. Use is limited, mostly concentrated in small town and livestock uses, and comprising only two percent of total countywide water supplies.

Comparison of Demand to Supply

- Current supplies are in excess of year 2050 M&I demands.
- Manufacturing and steam-electric shows a projected shortage that can be satisfied by reclassifying existing surface water supplies to manufacturing use.
- Projected demands (Bell & Coryell Counties) at Fort Hood reflect expected on-base population during periods of full staffing and mobilization of reserve units. Projected demands for these conditions exceed water supply available from Fort Hood's water rights.
- City of Holland shows a projected shortage after 2010.
- Morgans Point Resort shows an existing shortage.

- Salado WSC, serving both the City and a larger service area, is projected to be water short beginning about 2020.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Temple surface water supply is limited by raw water conveyance capacity.
- Salado WSC surface water supply, which serves the City of Salado and County-Other is limited due to no infrastructure. Additionally, a portion of their surface water supply contract with BRA from Stillhouse Hollow Reservoir expires in 2021.
- Kempner WSC (serves County-Other) surface water supply from a contract with Central Texas WSC is limited due to facility capacity.

4.2.2 Comparison of Demand to Supply – Bosque County

- Water demand and potential supply summary for all six use categories (Table 4-3).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-4).

Demands

- Water demand projections for 18 rural municipal water systems in Bosque County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases from 3,176 acft to 3,617 acft.
- Steam-electric demand of 5,600 acft is projected by 2010.
- For 2000 to 2050 period, projected manufacturing demand increases from 857 acft to 1,336 acft; manufacturing demand is about 20 percent of countywide M&I use.
- Irrigation and livestock demand stays fairly constant at about 2,200 acft (34 percent of total demand in 2000). With increasing M&I demand, agricultural demands decrease to 17 percent by 2050.

Supplies

- Surface water supply is obtained from the North Bosque River and other local sources.
- Groundwater sources are the Brazos River Alluvium and Trinity aquifers.

Comparison of Demand to Supply

- County summary shows immediate M&I shortages due to limited groundwater supply during dry conditions.
- The City of Clifton has sufficient water due to groundwater and recent development of surface water supplies.
- Due to limited groundwater supply, the City of Meridian has a current water shortage. by 2010.
- Due to limited groundwater availability, County-Other shows a current and long-term shortage.
- Due to limited groundwater availability, Manufacturing shows a current and long-term shortage.
- Projected steam-electric demand of 5,600 acft cannot be met with current supplies.
- There are sufficient agricultural water supplies through the 2050.

Water Supply Constraints

- City of Clifton surface water supply is limited by infrastructure capacity.

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4.2.3 Comparison of Demand to Supply – Brazos County

- Water demand and potential supply summary for all six use categories (Table 4-5).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-6).

Demands

- Water demand projections for five rural municipal water systems in Brazos County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases from 35,104 acft to 58,765 acft.
- Projected steam-electric demand of 5,000 acft stays constant; manufacturing demand increases slightly over the planning period.
- Irrigation and livestock demand decreases over the planning period from 10,946 acft to 8,887 acft. Irrigation demand decreases from 18 percent of county total demand to 10 percent due to the increasing share of M&I uses.

Supplies

- Surface water is obtained from the Brazos River Authority and local sources.
- Abundant groundwater supplies in Brazos County include the Carrizo-Wilcox, Brazos River Alluvium, Gulf Coast, Sparta, and Queen City aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through the year 2050.
- There are sufficient agricultural water supplies through the year 2050.

Water Supply Constraints

- City of Bryan groundwater supply is limited by well capacity.
- City of College Station / Texas A&M groundwater supply is limited by well capacity.
- Texas A&M surface water supply from a BRA contract from Lake Limestone is limited due to no infrastructure.
- Wellborn WSC (serves County-Other) surface water supply from a BRA contract from Lake Limestone is limited due to no infrastructure.

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4.2.4 Comparison of Demand to Supply – Burleson County

- Water demand and potential supply summary for all six use categories (Table 4-7).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-8).

Demands

- Water demand projections for 14 rural municipal water systems in Burleson County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases from 2,196 acft to 2,518 acft.
- Projected irrigation and livestock demand decreases over the planning period from 7,930 acft/yr to 6,662 acft/yr. Over time, irrigation demand decreases from 64 percent of county total demand to 57 percent.

Supplies

- Surface water is from local sources.
- Abundant groundwater supplies in Burleson County include the Carrizo-Wilcox, Brazos River Alluvium, Sparta and Queen City aquifers.
- Groundwater use from the Alluvium and Carrizo are the majority of county water supplies. Groundwater supplies above current use are available in Burleson County and have been prorated among users to meet projected demands. In most cases, users will need to construct facilities to utilize available groundwater to meet increased demands.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through the 2050.

Water Supply Constraints

- City of Caldwell groundwater supply is limited by well capacity.
- City of Somerville groundwater supply is limited by well capacity.

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4.2.5 Comparison of Demand to Supply – Callahan County

- Water demand and potential supply summary for all six use categories (Table 4-9).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-10).

Demands

- Water demand projections for four rural municipal water systems in Callahan County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, projected municipal demand decreases from 1,700 acft/yr to 1,308 acft/yr.
- Irrigation and livestock projected demand decreases over the planning period from 1,535 acft/yr to 1,484 acft/yr.

Supplies

- Surface water supply is from local sources.
- Groundwater supply is obtained from the Trinity Aquifer.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- The City of Baird is showing current and long-term shortages.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- Westbound WSC (serves County-Other) surface water supply is limited due to expiring contract with the City of Eastland in 2022.

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4.2.6 Comparison of Demand to Supply – Comanche County

- Water demand and potential supply summary for all six use categories (Table 4-11).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-12).

Demands

- Water demand projections for three rural municipal water systems in Comanche County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, projected municipal demand decreases from 1,902 acft/yr to 1,755 acft/yr.
- Irrigation and livestock projected demand decreases over the planning period from 53,283 acft/yr to 50,750 acft/yr.
- Irrigation demand comprises about 90 percent of total water demand in the county.

Supplies

- Surface water supplies are obtained from Lake Proctor and other local sources.
- Groundwater supply is obtained from the Trinity Aquifer.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- A current and longer-term water shortage was identified for irrigation use.

Water Supply Constraints

- None.

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4.2.7 Comparison of Demand to Supply – Coryell County

- Water demand and potential supply summary for all six use categories (Table 4-13).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-14).

Demands

- Water demand projections for 13 rural municipal water systems in Coryell County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, projected municipal demand increases from 14,505 acft/yr to 26,265 acft/yr.
- Irrigation and livestock projected demand decreases slightly over the planning period from 1,749 acft/yr to 1,587 acft/yr.

Supplies

- Surface water supplies are obtained from Lakes Belton and Stillhouse Hollow and other local supplies.
- Groundwater supply is obtained from the Trinity Aquifer.

Comparison of Demand to Supply

- A longer-term water shortage was identified for M&I uses after 2020.
- City of Copperas Cove is projected to have a shortage after 2020.
- City of Gatesville is projected to have a shortage after 2010.
- Fort Hood (Coryell County portion) is experiencing current and long-term shortages.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- Projected demands (Bell & Coryell Counties) at Fort Hood reflect expected on-base population during periods of full staffing and mobilization of reserve units. Projected demands for these conditions exceed water supply available from Fort Hood’s water rights.
- City of Gatesville surface water supply is limited due to expiring BRA contract from Lake Belton in 2021.
- Kempner WSC (serves County-Other) surface water supply from a contract with Central Texas WSC is limited due to facility capacity.

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4.2.8 Comparison of Demand to Supply – Eastland County

- Water demand and potential supply summary for all six use categories (Table 4-15).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-16).

Demands

- Water demand projections for five rural municipal water systems in Eastland County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, projected municipal demand decreases from 3,739 acft/yr to 2,805 acft/yr.
- Irrigation and livestock projected demand stays fairly constant over the planning period at about 13,750 acft/yr, comprising about 92 percent of total water demand.

Supplies

- Surface water supplies are obtained from Lakes Leon and Cisco and other local sources. Surface water supply amounts are declining due to sedimentation of reservoirs and resulting loss of reservoir volume and firm yield.
- Groundwater supply is obtained from the Trinity Aquifer.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- However within the county total, the City of Cisco has a current and long-term shortage.
- There is a current and long-term irrigation shortage.

Water Supply Constraints

- City of Eastland surface water supply is limited due to expiring contract with Eastland County WSD in 2032.
- City of Ranger surface water supply is limited due to expiring contract with Eastland County WSD in 2032.
- Mining water supply is limited due to expiring contract with BRA from Possum Kingdom Reservoir in 2016.

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4.2.9 Comparison of Demand to Supply – Erath County

- Water demand and potential supply summary for all six use categories (Table 4-17).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-18).

Demands

- Water demand projections for four rural municipal water systems in Erath County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, projected municipal demand increases from 5,312 acft/yr to 6,805 acft/yr.
- Irrigation and livestock projected demand stays fairly constant over the planning period at about 16,500 acft/yr and comprises about 43 percent of total water demand.

Supplies

- Surface water supplies are obtained from Lake Proctor and other local sources.
- Groundwater supply is obtained from the Trinity Aquifer.

Comparison of Demand to Supply

- County summary shows immediate shortages in municipal supply.
- City of Stephenville shows a current and continuing water supply shortage.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Stephenville surface water supply is limited due to no infrastructure from Lake Proctor.

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4.2.10 Comparison of Demand to Supply – Falls County

- Water demand and potential supply summary for all six use categories (Table 4-19).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-20).

Demands

- Water demand projections for 13 rural municipal water systems in Falls County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, municipal demand increases from 2,860 acft to 3,164 acft.
- Irrigation and livestock projected demand decreases over the planning period from 7,586 acft/yr to 6,647 acft/yr with irrigation demand decreasing from 59 percent of county total demand to 53 percent.

Supplies

- Surface water supplies are obtained from local sources and the Brazos River Authority.
- Abundant groundwater supplies include the Brazos River Alluvium, Carrizo-Wilcox, and the Trinity aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Marlin surface water supply from Brushy Creek Reservoir is limited due to no infrastructure.

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4.2.11 Comparison of Demand to Supply – Fisher County

- Water demand and potential supply summary for all six use categories (Table 4-21).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-22).

Demands

- Water demand projections for four rural municipal water systems in Fisher County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand decreases from 852 acft to 648 acft.
- Irrigation and livestock demand is projected to decrease slightly over the planning period from 3,242 acft/yr to 2,888 acft/yr; irrigation demand is about 54 percent of county total demand.

Supplies

- Surface water supplies are obtained from local sources, the Colorado River MWD, and the Cities of Sweetwater and Stamford.
- Groundwater supplies are obtained from the Seymour and Dockum aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Roby surface water supply is limited due to expiring contract with City of Sweetwater in 2023.
- Bitter Creek WSC (serves County-Other) surface water supply is limited due to expiring contract with City of Sweetwater in 2013.

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4.2.12 Comparison of Demand to Supply – Grimes County

- Water demand and potential supply summary for all six use categories (Table 4-23).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-24).

Demands

- Water demand projections for 10 rural municipal water systems in Grimes County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, municipal demand increases from 2,778 acft to 3,441 acft.
- Irrigation and livestock projected demand stays constant over the planning period at 2,058 acft/yr.

Supplies

- Surface water use for use in steam-electric cooling is provided from Gibbons Creek Reservoir and Lake Limestone.
- Abundant groundwater supplies that currently meet other water uses in Grimes County are available from the Gulf Coast, Carrizo-Wilcox, Sparta, Brazos River Alluvium, and Queen City aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Anderson groundwater supply is limited by well capacity.
- City of Navasota groundwater supply is limited by well capacity.

Table 4-23. Grimes County Population, Water Supply, and Water Demand Projections

Population Projection	2000	2010	2020	2030	2040	2050
	21,545	24,534	27,302	29,814	29,659	33,190

	Supply and Demand by Type of Use	2000 (acft)	2010 (acft)	2020 (acft)	2030 (acft)	2040 (acft)	2050 (acft)
Municipal	Municipal Demand	2,778	2,923	3,067	3,237	3,128	3,441
	Municipal Existing Supply						
	Groundwater	19,167	19,167	19,167	19,167	19,167	19,167
	Surface water	0	0	0	0	0	0
	Total Existing Municipal Supply	19,167	19,167	19,167	19,167	19,167	19,167
	Municipal Balance	16,389	16,244	16,100	15,930	16,039	15,726
Industrial	Manufacturing Demand	280	314	351	391	435	483
	Manufacturing Existing Supply						
	Groundwater	1,340	1,340	1,340	1,340	1,340	1,340
	Surface water	0	0	0	0	0	0
	Total Manufacturing Supply	1,340	1,340	1,340	1,340	1,340	1,340
	Manufacturing Balance	1,060	1,026	989	949	905	857
	Steam-Electric Demand	10,000	16,721	16,721	16,721	16,721	16,721
	Steam-Electric Existing Supply						
	Groundwater	0	0	0	0	0	0
	Surface water	10,000	16,721	16,721	16,721	16,721	16,721
	Total Steam-Electric Supply	10,000	16,721	16,721	16,721	16,721	16,721
	Steam-Electric Balance	0	0	0	0	0	0
	Mining Demand	273	255	236	219	213	212
	Mining Existing Supply						
	Groundwater	276	276	276	276	276	276
	Surface water	0	0	0	0	0	0
	Total Mining Supply	276	276	276	276	276	276
	Mining Balance	3	21	40	57	63	64
Agriculture	Irrigation Demand	125	125	125	125	125	125
	Irrigation Existing Supply						
	Groundwater	689	689	689	689	689	689
	Surface water	1,471	1,471	1,471	1,471	1,471	1,471
	Total Irrigation Supply	2,160	2,160	2,160	2,160	2,160	2,160
	Irrigation Balance	2,035	2,035	2,035	2,035	2,035	2,035
	Livestock Demand	1,933	1,933	1,933	1,933	1,933	1,933
	Livestock Existing Supply						
	Groundwater	3,606	3,606	3,606	3,606	3,606	3,606
	Surface water	0	0	0	0	0	0
	Total Livestock Supply	3,606	3,606	3,606	3,606	3,606	3,606
	Livestock Balance	1,673	1,673	1,673	1,673	1,673	1,673
Total	Municipal & Industrial Demand	13,331	20,213	20,375	20,568	20,497	20,857
	Existing Municipal & Industrial Supply						
	Groundwater	20,783	20,783	20,783	20,783	20,783	20,783
	Surface water	10,000	16,721	16,721	16,721	16,721	16,721
	Total Municipal & Industrial Supply	30,783	37,504	37,504	37,504	37,504	37,504
	Municipal & Industrial Balance	17,452	17,291	17,129	16,936	17,007	16,647
	Agriculture Demand	2,058	2,058	2,058	2,058	2,058	2,058
	Existing Agricultural Supply						
	Groundwater	4,295	4,295	4,295	4,295	4,295	4,295
	Surface water	1,471	1,471	1,471	1,471	1,471	1,471
	Total Agriculture Supply	5,766	5,766	5,766	5,766	5,766	5,766
	Agriculture Balance	3,708	3,708	3,708	3,708	3,708	3,708
	Total Demand	15,389	22,271	22,433	22,626	22,555	22,915
	Total Supply						
	Groundwater	25,078	25,078	25,078	25,078	25,078	25,078
	Surface water	11,471	18,192	18,192	18,192	18,192	18,192
	Total Supply	36,549	43,270	43,270	43,270	43,270	43,270
	Total Balance	21,160	20,999	20,837	20,644	20,715	20,355

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4.2.13 Comparison of Demand to Supply – Hamilton County

- Water demand and potential supply summary for all six use categories (Table 4-25).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-26).

Demands

- Water demand projections for 3 rural municipal water systems in Hamilton County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, projected municipal demand decreases from 1,301 acft/yr to 819 acft/yr.
- Irrigation and livestock projected demand stays fairly constant over the planning period at about 3,400 acft/yr and comprises about 48 percent of total water demand.

Supplies

- Surface water supplies are obtained from Lake Proctor and other local sources.
- Groundwater supply is obtained from the Trinity Aquifer.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- None.

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4.2.14 Comparison of Demand to Supply – Haskell County

- Water demand and potential supply summary for all six use categories (Table 4-27).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-28).

Demands

- Water demand projections for eight rural municipal water systems in Haskell County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, projected municipal demand increases slightly from 996 acft/yr to 1,008 acft/yr.
- Irrigation and livestock projected demand decreases over the planning period from 22,445 acft/yr to 19,412 acft/yr.
- Steam-electric demand increases sharply from 700 acft/yr in 2000 to 3,000 acft/yr in 2020.

Supplies

- Surface water supplies are obtained from local sources and Lakes Millers Creek and Stamford.
- Groundwater supply is obtained from the Seymour Aquifer.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- However, within the total, the City of Haskell is shown to experience a water shortage unless additional contract supplies can be obtained (see below).
- Additionally, a shortage is anticipated in the steam-electric sector.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Haskell surface water supply is limited due to expiring contract with North Central Texas MWD in 2010.
- City of Rule surface water supply is limited due to expiring contract with North Central Texas MWD in 2019.

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4.2.15 Comparison of Demand to Supply – Hill County

- Water demand and potential supply summary for all six use categories (Table 4-29).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-30).

Demands

- Water demand projections for 28 rural municipal water systems in Hill County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, projected municipal demand increases slightly from 4,170 acft/yr to 4,228 acft/yr.
- Irrigation and livestock projected demand stays fairly constant over the planning period at about 1,630 acft/yr.

Supplies

- Surface water supplies are obtained from the Lakes Aquilla and Whitney and local supplies. Supply in Lake Aquilla is declining due to sedimentation.
- Groundwater supplies are obtained from the Trinity and Woodbine aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- However, within the total, the manufacturing sector is showing a continuing, small deficit. Sufficient water from municipal supply can likely be transferred as necessary to meet these manufacturing needs.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Itasca groundwater supply is limited by well capacity.
- City of Whitney groundwater supply is limited by well capacity.
- City of Whitney sufrace water supply from a BRA contract from Lake Whitney is limited due to no infrastructure.

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4.2.16 Comparison of Demand to Supply – Hood County

- Water demand and potential supply summary for all six use categories (Table 4-31).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-32).

Demands

- Water demand projections for 38 rural municipal water systems in Hood County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, projected municipal demand increases from 4,947 acft/yr to 10,981 acft/yr.
- Projected steam-electric demand increases from 4,500 acft/yr to 6,700 acft/yr.
- Irrigation and livestock projected demand decreases slightly over the planning period from 7,319 acft/yr to 6,707 acft/yr.

Supplies

- Surface water supplies are obtained from Lakes Granbury and Possum Kingdom and other local sources.
- Groundwater supply is obtained from the Trinity.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- However, the City of Granbury is showing shortages due to constraints (see below).
- There are sufficient agricultural water supplies through the year 2050.

Water Supply Constraints

- City of Granbury groundwater supply is limited by well capacity.
- City of Granbury surface water supply from BRA contracts from Lake Granbury and Possum Kingdom Reservoir is limited by infrastructure capacity.
- Acton MUD (serves County-Other) surface water supply from BRA contracts from Lake Granbury and Possum Kingdom Reservoir is limited by infrastructure capacity.

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4.2.17 Comparison of Demand to Supply – Johnson County

- Water demand and potential supply summary for all six use categories (Table 4-33).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-34).

Demands

- Water demand projections for 25 rural municipal water systems in Johnson County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, projected municipal demand increases from 18,879 acft/yr to 32,288 acft/yr.
- Irrigation and livestock projected demand is constant over the planning period at 2,582 acft/yr.

Supplies

- Surface water supplies are provided by Lakes Granbury, Whitney, Aquilla, and Pat Cleburne, and other local sources.
- Minor groundwater supplies are obtained from the Trinity and Woodbine aquifers.

Comparison of Demand to Supply

- M&I supply shortages are projected prior after 2030.
- City of Keene has a current and long-term shortage.
- City of Venus has a current and long-term shortage.
- County-Other municipal needs are shown to have a current and long-term shortage.
- Manufacturing needs are shown to have a current and long-term shortage.
- Not shown in Table 4-33 is a 2,117 acft/yr Steam-Electric Demand from the Tenaska power plant in Cleburne. This demand is met from 448 of existing municipal supply, and 1,669 acft/yr of reuse water.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Alvarado surface water supply is limited due to expiring contract with Johnson County Rural WSC in 2001.
- City of Cleburne surface water supply from BRA contract from Lake Whitney is limited due to no infrastructure.
- City of Joshua (Johnson County FWSD) surface water supply from BRA contract from Lake Granbury is limited by infrastructure capacity.
- Johnson County Rural WSC (serves County-Other) surface water supply from BRA contract from Lake Granbury is limited by infrastructure capacity.

4.2.18 Comparison of Demand to Supply – Jones County

- Water demand and potential supply summary for all six use categories (Table 4-35).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-36).

Demands

- Water demand projections for six rural municipal water systems in Jones County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, projected municipal demand increases from 3,289 acft/yr to 3,692 acft/yr.
- Irrigation and livestock projected demand decreases over the planning period from 4,682 acft/yr to 4,145 acft/yr.

Supplies

- Surface water supplies are obtained from Fort Phantom Hill Reservoir and through water purchase contracts with West Central Texas Municipal Water District for water from Hubbard Creek Reservoir and small reservoirs. Surface water supply is declining due to sedimentation of reservoirs and resulting loss of reservoir volume and firm yield.
- Groundwater supply is obtained from the Seymour aquifer.

Comparison of Demand to Supply

- M&I water shortages at the county level are projected after 2010.
- City of Stamford supply is first allocated to meet wholesale contract obligations. Remaining supply is shown in Table 4-36. Supply decreases due to sedimentation of Lake Stamford.
- City of Hamlin is showing shortages due to constraints (see below).
- County-Other is showing current and long-term shortages.
- Manufacturing is showing current and long-term shortages.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Hamlin surface water supply is limited by conveyance capacity.

4.2.19 Comparison of Demand to Supply – Kent County

- Water demand and potential supply summary for all six use categories (Table 4-37).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-38).

Demands

- Water demand projections for six rural municipal water systems in Kent County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, municipal demand decreases from 207 acft to 116 acft.
- Mining use is projected to decline substantially over time.
- Irrigation and livestock demand is projected to decline slightly from 965 acft to 880 acft in 2050.

Supplies

- Surface water supply is obtained from local sources and used for livestock watering.
- Primary groundwater sources are the Seymour and Dockum.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Jayton groundwater supply is limited by well capacity.

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4.2.20 Comparison of Demand to Supply – Knox County

- Water demand and potential supply summary for all six use categories (Table 4-39).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-40).

Demands

- Water demand projections for six rural municipal water systems in Knox County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand decreases slightly from 908 acft to 897 acft.
- No manufacturing or steam-electric demand is forecast for the county, and a small mining use is projected to decline slightly over time.
- Irrigation demand is projected to decline from 31,529 acft in 2000 to 27,843 acft in 2050, but still comprising about 95 percent of total county use.

Supplies

- Small surface water supplies are obtained from Millers Creek Reservoir and local sources.
- Primary groundwater sources are the Seymour and Blaine aquifers.

Comparison of Demand to Supply

- Due to constraints, M&I shows a shortage beginning after 2010 (see below).
- Agriculture shows a current and long-term shortage.

Water Supply Constraints

- City of Benjamin groundwater supply is limited by well capacity.
- City of Knox City surface water supply is limited due to expiring contract with North Central Texas MWD in 2010.
- City of Munday surface water supply is limited due to expiring contract with North Central Texas MWD in 2010.
- City of Goree (in County-Other) surface water supply is limited due to expiring contract with North Central Texas MWD in 2010.

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4.2.21 Comparison of Demand to Supply – Lampasas County

- Water demand and potential supply summary for all six use categories (Table 4-41).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-42).

Demands

- Water demand projections for three rural municipal water systems in Lampasas County were calculated to support county-other municipal projections.
- For the year 2000 to 2050 period, municipal demand increases from 3,225 acft to 5,586 acft.
- Manufacturing use is forecast to increase slightly and mining use remain about the same.
- Irrigation and livestock demand stays fairly constant at about 1,160 acft, ranging from about 16 to 25 percent of total demand over time.

Supplies

- Surface water supplies are obtained from Lake Stillhouse Hollow, Sulphur Creek, and other local.
- Primary groundwater sources are the Marble Falls, Trinity, and Ellenburger-San Saba aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Lampasas surface water supply from a contract with Kempner WSC is limited due to facility capacity.

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4.2.22 Comparison of Demand to Supply – Lee County

- Water demand and potential supply summary for all six use categories (Table 4-43).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-44).

Demands

- Water demand projections for six rural municipal water systems in Lee County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases from 3,226 acft to 4,150 acft.
- Mining water use is projected to increase significantly by the year 2010 as new lignite mining blocks are opened in the county.
- For the year 2000 to 2050 period, manufacturing demand increases slightly.
- Irrigation and livestock demand stays fairly constant at about 1,975 acft.

Supplies

- Surface water is obtained from local sources, and its current use is very limited.
- Groundwater sources are the Carrizo-Wilcox, Sparta, and Queen City aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Giddings groundwater supply is limited by well capacity.
- City of Lexington groundwater supply is limited by well capacity

Contracts to Supply San Antonio Water System

- The San Antonio Water System (SAWS), located in the South Central Texas Region (L), has contracted to purchase Carrizo-Wilcox Aquifer groundwater produced from land owned or leased by Aluminum Company of America (Alcoa) in Milam, Lee, and Bastrop Counties. The Region L water plan calls for 55,000 acft/yr to be purchased through this contract. Water to be sold by Alcoa originates primarily from their on-going lignite mining activities. Water not originating from mining activities will be obtained by pumping groundwater on land leased from San Antonio City Public Service. Table 4-43A reports water quantities to be delivered from Lee County to SAWS consistent with the water plan being prepared by the South Central Texas Region RWPG.

4.2.23 Comparison of Demand to Supply – Limestone County

- Water demand and potential supply summary for all six use categories (Table 4-45).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-46).

Demands

- Water demand projections for 16 rural municipal water systems in Limestone County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand slightly increases from 3,482 acft to 3,837 acft.
- Steam-electric demand of 20,000 acft is projected by 2010.
- For the year 2000 to 2050 period, manufacturing demand increases significantly from 453 acft to 1,061 acft., but still only comprises about 3 to 4 percent of countywide M&I use.
- Irrigation and livestock demand stays fairly constant at 1,427 acft, or 5 to 6 percent of total countywide demand.

Supplies

- Surface water supplies are obtained from Lakes Limestone and Mexia and other local sources.
- Groundwater sources are Carrizo-Wilcox, Trinity, and Woodbine aquifers.

Comparison of Demand to Supply

- The City of Groesbeck is experiencing current and long-term shortages.
- A small water shortage is projected in the manufacturing sector that might be addressed through the provision of municipal or steam-electric supplies.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Thorton groundwater supply is limited by well capacity.
- Bistone WSD (serve County-Other) surface water supply is limited due to infrastructure capacity.

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4.2.24 Comparison of Demand to Supply – McLennan County

- Water demand and potential supply summary for all six use categories (Table 4-47).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-48).

Demands

- Water demand projections for 46 rural municipal water systems in McLennan County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, municipal demand increases from 45,387 acft to 59,925 acft.
- Steam-electric demand of 35,000 acft is projected to be needed by 2050.
- For the year 2000 to 2050 period, manufacturing demand increases from 3,106 acft to 5,652 acft, comprising about 5 percent of countywide M&I use.
- Irrigation and livestock demand stays fairly constant at 4,935 acft, or about 5 to 7 percent of total countywide demand.

Supplies

- Surface water supplies are obtained from Lake Waco, Tradinghouse Creek Reservoir, Lake Creek Reservoir, Brazos River Authority, and other local sources
- Groundwater sources are the Brazos River Alluvium, Trinity, and Woodbine aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- Groundwater shortages are also identified in the mining sector.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Robinson surface water supply is limited due to infrastructure capacity.

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4.2.25 Comparison of Demand to Supply – Milam County

- Water demand and potential supply summary for all six use categories (Table 4-49).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-50).

Demands

- Water demand projections for nine rural municipal water systems in Milam County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases from 5,032 acft to 5,460 acft.
- Current steam-electric demand of 8,860 acft is projected to increase to 16,000 acft by 2050.
- For the year 2000 to 2050 period, manufacturing demand increases from 6,820 acft to 9,800 acft; manufacturing demand is about 14 percent of countywide M&I use.
- Irrigation and livestock demand stays fairly constant at about 3,000 acft.

Supplies

- Surface water supplies are obtained from the Lakes ALCOA and Granger and other local sources.
- Groundwater sources are the Carrizo-Wilcox and Trinity aquifers.

Comparison of Demand to Supply

- There are sufficient municipal supplies through 2050.
- Steam-Electric shows a shortage beginning in 2020; this shortage could be met with surplus manufacturing groundwater supplies.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Rockdale groundwater supply is limited by well capacity.
- City of Thorndale surface water supply from Brushy Creek is limited due to no infrastructure.
- ALCOA steam-electric surface water supply is limited due to expiring BRA contract from Lake Granger in 2019.

Contracts to Supply San Antonio Water System

- The San Antonio Water System (SAWS), located in the South Central Texas Region (L), has contracted to purchase Carrizo-Wilcox Aquifer groundwater produced from land owned or leased by Aluminum Company of America (Alcoa) in Milam, Lee, and Bastrop Counties. The Region L water plan calls for 55,000 acft/yr to be purchased through this contract. Water to be sold by Alcoa originates primarily from their on-going lignite mining activities. Water not originating from mining activities will be obtained by pumping groundwater on land leased from San Antonio City Public Service. Table 4-49A reports water quantities to be delivered from Milam County to SAWS consistent with the water plan being prepared by the South Central Texas Region RWPG.

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4.2.26 Comparison of Demand to Supply – Nolan County

- Water demand and potential supply summary for all six use categories (Table 4-51).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-52).

Demands

- Water demand projections for four rural municipal water systems in Nolan County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand decreases from 4,909 acft to 4,377 acft.
- For 2000 to 2050 period, manufacturing demand increases from 558 acft to 885 acft, and comprises about 9 percent of current countywide M&I use.
- Irrigation and livestock demand stays fairly constant at about 2,600 acft or 32 percent of total countywide demand.

Supplies

- Surface water supplies are obtained from Oak Creek Reservoir, Lakes Sweetwater and Trammel, and other local sources.
- Groundwater sources are the Dockum and Edwards-Trinity (Plateau) aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- Within that total, there is a current and long term manufacturing shortage.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- Bitter Creek WSC, City of Trent, and Fort Chadborne Ranch (all serve County-Other) surface water supplies are limited due to expiring contracts with City of Sweetwater in 2013, 2023, and 2013 respectively.

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4.2.27 Comparison of Demand to Supply – Palo Pinto County

- Water demand and potential supply summary for all six use categories (Table 4-53).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-54).

Demands

- Water demand projections for nine rural municipal water systems in Palo Pinto County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases slightly from 4,348 acft to 4,714 acft.
- Steam-electric demand of 3,000 acft is projected by 2010.
- For 2000 to 2050 period, manufacturing demand increases slightly from 65 acft to 125 acft, but is only about 0.9 percent of countywide M&I use.
- Irrigation and livestock demand stays fairly constant at about 1,500 acft or 17 percent of total countywide.

Supplies

- Surface water supplies are obtained from Possum Kingdom reservoir, Lake Palo Pinto, and other local sources.
- Groundwater source is the Trinity Aquifer.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- Due to constraints the City of Palo Pinto is showing a shortage in 2010 (see below).
- There are sufficient agricultural supplies through 2050.

Water Supply Constraints

- City of Graford surface water supply is limited due to expiring contract with the City of Mineral Wells in 2040.
- City of Mineral Wells surface water supply is limited by raw water capacity.
- City of Palo Pinto surface water supply is limited due to expiring contract with the City of Mineral Wells in 2007.
- County-Other surface water supply is limited due to expiring contracts with the City of Mineral Wells.

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4.2.28 Comparison of Demand to Supply – Robertson County

- Water demand and potential supply summary for all six use categories (Table 4-55).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-56).

Demands

- Water demand projections for nine rural municipal water systems in Robertson County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, municipal demand increases from 2,936 acft to 3,598 acft.
- Current steam-electric water demand of 15,000 acft is projected to significantly increase to 40,000 acft by the year 2050.
- Small manufacturing demands are expected to increase from 42 acft in 2000 to 98 acft in 2050, but comprise only about 0.2 percent of countywide M&I use.
- Irrigation and livestock demand are forecast to decline slightly from 22,449 acft (55 percent of county use) in the year 2000 to 20,083 (31 percent of county use) by 2050.

Supplies

- Surface water supplies are obtained from Lake Limestone and Twin Oaks Reservoir.
- Groundwater sources are the Carrizo-Wilcox, Brazos River Alluvium, Sparta, and Queen City aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- Due to constraints, the City of Hearne is showing shortages prior to 2030 (see below).
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- City of Franklin groundwater supply is limited by well capacity.
- City of Hearne groundwater supply is limited by well capacity.

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4.2.29 Comparison of Demand to Supply – Shackelford County

- Water demand and potential supply summary for all six use categories (Table 4-57).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-58).

Demands

- Water demand projections for five rural municipal water systems in Shackelford County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand decreases from 751 acft to 493 acft.
- Mining demand is expected to decline slightly from 433 acft in 2000 to 390 acft by 2050.
- Irrigation and livestock demand stays fairly constant at around 975 acft or 45 percent of total demand.

Supplies

- Surface water supplies are obtained from local sources and the City of Abilene.
- No major or minor aquifer groundwater use is reported in the county.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050 with the exception of noticeable shortages projected for the mining sector.
- There are current and long-term shortages in agriculture.

Water Supply Constraints

- None.

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4.2.30 Comparison of Demand to Supply – Somervell County

- Water demand and potential supply summary for all six use categories (Table 4-59).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-60).

Demands

- Water demand projections for one rural municipal water system in Somervell County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases from 1,029 acft to 2,487 acft.
- Current steam-electric demand of 18,000 acft for the nuclear plant is projected to increase slightly to 23,200 acft by 2010.
- No manufacturing water demand is predicted, and mining use is anticipated to decrease slightly.
- Irrigation and livestock demand stays fairly constant at about 465 acft or 2 percent of total countywide demand.

Supplies

- Surface water supplies are obtained from Squaw Creek Reservoir, Brazos River Authority, and other local sources.
- Minor groundwater supplies are obtained from the Trinity Aquifer.

Comparison of Demand to Supply

- The county summary shows near-term M&I shortages in drought conditions due to limited groundwater supply.
- The City of Glen Rose is indicated to be currently water short during dry years due to limited groundwater supply and will need an additional supplies in the future.
- County-Other municipal, mostly around Glen Rose, also show significant shortages due to dependence on limited groundwater.
- There are sufficient agricultural water supplies through the 2050.

Water Supply Constraints

- None.

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4.2.31 Comparison of Demand to Supply – Stephens County

- Water demand and potential supply summary for all six use categories (Table 4-61).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-62).

Demands

- Water demand projections for four rural municipal water system in Stephens County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand decreases from 1,983 acft to 1,840 acft.
- A small amount of manufacturing water use and no steam-electric demand is forecast. Mining use is predicted to decrease over time.
- Irrigation and livestock demand stays fairly constant at about 1,250 acft or around 34 percent of total countywide demand.

Supplies

- Surface water supply is obtained from Hubbard Creek Reservoir and local sources.
- Limited use from small unclassified groundwater resources.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are current and long-term shortages in agriculture.

Water Supply Constraints

- None.

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4.2.32 Comparison of Demand to Supply – Stonewall County

- Water demand and potential supply summary for all six use categories (Table 4-63).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-64).

Demands

- Water demand projections for one rural municipal water system in Stonewall County were calculated to support County-Other municipal projections.
- For the year 2000 to 2050 period, municipal demand decreases from 371 acft to 271 acft.
- No manufacturing or steam-electric demand is forecast, and mining uses are predicted to drop from 219 acft to 17 acft over the 50-year planning period.
- Irrigation and livestock demand stays fairly constant at around 1,100 acft over the planning period or about 65 percent of total demand.

Supplies

- Surface water supply is obtained from local sources.
- Groundwater supply is primarily from the Seymour Aquifer.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are current and long-term shortages in agriculture.

Water Supply Constraints

- City of Aspermont groundwater supply is limited by well capacity.
- City of Aspermont surface water supply is limited due to expiring contract with North Central Texas MWD in 2019.

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4.2.33 Comparison of Demand to Supply – Taylor County

- Water demand and potential supply summary for all six use categories (Table 4-65).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-66).

Demands

- Water demand projections for 13 rural municipal water systems in Taylor County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases from 30,682 acft to 42,399 acft.
- For 2000 to 2050 period, manufacturing demand increases from 1,775 acft to 2,575 acft and comprises about 5 percent of countywide M&I use.
- Steam-electric demand of 300 acft/year is projected stay constant while mining uses are anticipated to decrease slightly.
- Irrigation and livestock demand stays fairly constant at about 4,100 acft/year or about 8 to 11 percent of total demand.

Supplies

- Surface water supplies are obtained from the Lakes Hubbard Creek, Abilene, Kirby, and local sources.
- Minor groundwater supplies are obtained from the Trinity and Edwards-Trinity (Plateau) aquifers.

Comparison of Demand to Supply

- The City of Abilene shows a shortage prior to 2020 due to constraints (see below).
- The communities of Merkel and Tye are water short due to limited surface water availability.
- County summary shows near- and longer-term shortages in manufacturing, mining, and irrigation. Manufacturing shortages could potentially be met with other existing supplies available in the county. .

Water Supply Constraints

- City of Abilene surface water supply from Colorado River MWD is limited due to no infrastructure from Lake O.H. Ivie.

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4.2.34 Comparison of Demand to Supply – Throckmorton County

- Water demand and potential supply summary for all six use categories (Table 4-67).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-68).

Demands

- Water demand projections for three rural municipal water system in Throckmorton County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand decreases from 291 acft to 210 acft.
- No steam-electric or manufacturing demand is predicted, and mining uses should remain around 34 acft per year.
- No irrigation demand is forecast. Livestock demand stays fairly constant at 989 acft or about 75 percent of total demand.

Supplies

- Surface water supplies are obtained from Lake Throckmorton and other local sources.
- Limited use from small unclassified groundwater resources.

Comparison of Demand to Supply

- The City of Throckmorton appears to be in a new drought of record; a new firm yield for Lake Throckmorton needs to be evaluated after the current drought.
- County-Other municipal shows immediate shortages due to dependence on limited groundwater.
- There are sufficient agricultural water supplies through the year 2050.

Water Supply Constraints

- None.

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4.2.35 Comparison of Demand to Supply – Washington County

- Water demand and potential supply summary for all six use categories (Table 4-69).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-70).

Demands

- Water demand projections for 12 rural municipal water systems in Washington County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand decreases slightly from 4,459 acft to 4,152 acft.
- No steam-electric demand is forecast, and small mining uses should decrease slightly.
- For 2000 to 2050 period, manufacturing demand increases from 495 acft to 663 acft and comprises about 10 percent of countywide M&I use.
- Irrigation and livestock demand stays fairly constant at 1,709 acft or about 25 percent of total countywide use.

Supplies

- Surface water supplies are obtained from Lake Sommerville and other local sources.
- Groundwater sources are the Gulf Coast and Brazos River Alluvium aquifers.

Comparison of Demand to Supply

- There are sufficient M&I water supplies through 2050.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- None.

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4.2.36 Comparison of Demand to Supply – Williamson County

- Water demand and potential supply summary for all six use categories (Table 4-71).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-72).

Demands

- Water demand projections for 23 rural municipal water systems in Williamson County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand increases dramatically from 39,227 acft to 116,896 acft.
- No steam-electric demand is anticipated, but mining demand is expected to increase from 1,872 to 2,068 acft.
- For 2000 to 2050 period, manufacturing demand increases from 368 acft to 481 acft, comprising about 0.4 percent of countywide M&I use. [*Note: Projected manufacturing demand is reported from the 1997 Consensus State Water Plan data and appears relatively low for the level of economic activity in the county. Previously, the Trans-Texas Water Plan had projected 23,700 acft/yr of manufacturing demand in the county by 2050. This additional manufacturing water demand will be planned for accordingly.*]
- Irrigation and livestock demand stays fairly constant at about 170 acft over the planning period.

Supplies

- Surface water supplies are obtained from the Lake Georgetown, Stillhouse Hollow Reservoir, and Lake Travis.
- Groundwater sources are the Edwards (BFZ) and Trinity aquifers.

Comparison of Demand to Supply

- County summary shows immediate shortages in mining, and by 2030, in countywide municipal uses.
- Due to constraints (see below) Brushy Creek MUD, City of Georgetown, City of Leander, City of Round Rock, City of Taylor, and County Other are showing projected shortages.
- City of Florence is showing a shortage prior to 2010.
- City of Granger is showing a shortage prior to 2010.
- City of Hutto is showing a shortage prior to 2010.
- City of Thrall is showing a shortage prior to 2010.
- County-Other shows a current and long-term shortage.
- There are sufficient agricultural water supplies through 2050.

Water Supply Constraints

- Brushy Creek MUD surface water supply from a BRA contract from Stillhouse Hollow Reservoir is limited due to no infrastructure.
- Brushy Creek MUD surface water supply is limited due to expiring contract with City of Round Rock in 2006.
- City of Georgetown surface water supply from Lake Georgetown is limited due to infrastructure capacity.
- City of Leander surface water supply from Stillhouse Hollow is limited due to no infrastructure.
- City of Round Rock surface water supply from Lake Georgetown is limited due to infrastructure capacity.
- City of Taylor surface water supply from Lake Granger is limited due to infrastructure capacity.
- Jonah WSD (serves County-Other) surface water supply from Stillhouse Hollow Reservoir is limited due to infrastructure capacity.

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4.2.37 Comparison of Demand to Supply – Young County

- Water demand and potential supply summary for all six use categories (Table 4-73).
- Demand and supply summary for municipal use reflects supply constraints such as expiring contracts and infrastructure limitations (Table 4-74).

Demands

- Water demand projections for four rural municipal water systems in Young County were calculated to support County-Other municipal projections.
- For 2000 to 2050 period, municipal demand decreases from 2,828 acft to 2,414 acft.
- Steam-electric demand of 3,000 to 3,500 acft is projected to be needed in the near-term, comprising almost half of countywide water use.
- For 2000 to 2050 period, manufacturing demand increases from 158 acft to 299 acft, but comprises only about 4 percent of countywide M&I use.
- Irrigation and livestock demand is predicted to decline slightly from 1,335 acft to 1,257 acft by 2050.

Supplies

- Surface water supplies are obtained from the Lakes Graham and Eddleman, Whiskey Creek Reservoir, and other local sources.
- Limited use from small unclassified groundwater resources.

Comparison of Demand to Supply

- There are sufficient municipal water supplies through 2050.
- There are current and long-term manufacturing and steam-electric shortages.
- There are current and long-term agricultural shortages.

Water Supply Constraints

- City of Graham surface water supply from a BRA contract from Possum Kingdom Reservoir is limited due to no infrastructure.

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4.3 Major Water Providers

The term "Major Water Provider" (MWP) is new to Texas water planning and has been introduced through SB1 to recognize that many utilities obtain their water supply from regional (i.e., major) entities. Examples of MWPs could include river authorities, larger water districts, or cities providing water to surrounding areas. Each Regional Water Planning Group (RWPG) is required to identify and include MWPs in their water supply planning.

4.3.1 Major Water Provider List

The Brazos G RWPG has adopted by resolution the following entities as Major Water Providers[1]

1. Brazos River Authority
2. West Central Texas Municipal Water District
3. City of Abilene
4. City of Waco
5. City of Round Rock
6. Central Texas Water Supply Corporation
7. Bell County WCID No. 1
8. Lower Colorado River Authority

4.3.2 Major Water Provider Summary Sheets

Summaries of each MWP, including a brief description, contracts for water sales, and supplies are provided in Figures 4-1 through 4-8.

[1] Entities were identified as possible MWP's using this criteria: 1) Provides either raw or treated water for municipal and industrial purposes, and 2) of their 1996 total water use, they supplied more than 10 percent on a wholesale basis to long-term contract holders; and 3) their total water use in 1996 was more than 5,000 acft.

Name/Location: Brazos River Authority

Description: The primary provider of water to the Brazos G Region is the Brazos River Authority. The BRA also operates water and wastewater treatment systems, has programs to assess and protect water quality, does water supply planning and supports water conservation efforts in the Brazos River Basin. BRA provides water from three wholly owned and operated reservoirs in the region: Lake Granbury, Possum Kingdom Lake, and Lake Limestone. BRA also contracts for conservation storage space in the nine U.S. Army Corps of Engineers reservoirs in the region: Lakes Waco, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Somerville, Whitney, and Aquilla. The total permitted capacity of these twelve reservoirs in the BRA system is approximately 2.3 million acft. BRA holds rights for diversion in the region totaling more than 662,000 acft, and contracts to supply water to municipal, industrial and agricultural water customers in the BGRWPA and other regions. BRA's largest municipal customers in 1999 included Bell County Water Control and Improvement District No. 1, the City of Round Rock, and the Central Texas Water Supply Corporation.

Projected Demands:

Major Long-term Water Contracts *(as of December 1999)*	***Year (acft)***					
	2000	***2010***	***2020***	***2030***	***2040***	***2050***
Possum Kingdom/Granbury/Whitney	206,987	206,987	206,987	206,987	206,987	206,987
Stillhouse/Georgetown/Granger	92,944	92,944	92,944	92,944	92,944	92,944
Proctor	15,444	15,444	15,444	15,444	15,444	15,444
Belton	100,232	100,232	100,232	100,232	100,232	100,232
Aquilla	11,403	11,403	11,403	11,403	11,403	11,403
Limestone	54,809	54,809	54,809	54,809	54,809	54,809
Somerville	4,619	4,619	4,619	4,619	4,619	4,619
System[1]	137,293	137,293	137,293	137,293	137,293	137,293
Total Contracted Demand	623,731	623,731	623,731	623,731	623,731	623,731
Requested Additional Water Supply[2]	0	47,000	94,000	141,000	188,000	235,000
Projected Total Demand	623,731	670,731	717,731	764,731	811,731	858,731

[1] System demands may be met from any of the reservoirs in the BRA System.

[2] As of July 2000, BRA has a waiting list of requests from 35 entities wanting to purchase 235,932 acft/yr. Current supplies cannot meet this demand. Several entities have requested "all available water" in addition to the 235,932 acft. About 68 percent of the requested amount is from entities in Region H.

Supply (reservoir firm yield):

Source	***Year (acft)***					
	2000	***2010***	***2020***	***2030***	***2040***	***2050***
Possum Kingdom/Granbury/Whitney	348,408	345,409	342,410	339,412	336,413	333,414
Stillhouse/Georgetown/Granger	104,975	103,237	101,499	99,761	98,023	96,286
Proctor	21,897	21,683	21,469	21,254	21,040	20,826
Belton	106,511	106,001	105,491	104,981	104,471	103,961
Aquilla	13,478	11,805	10,132	8,460	6,787	5,114
Limestone	64,646	63,412	62,178	60,943	59,709	58,475
Somerville	41,191	40,681	40,171	39,661	39,151	38,641
System						
Total Supply[1]	701,106	692,228	683,350	674,472	665,594	656,717

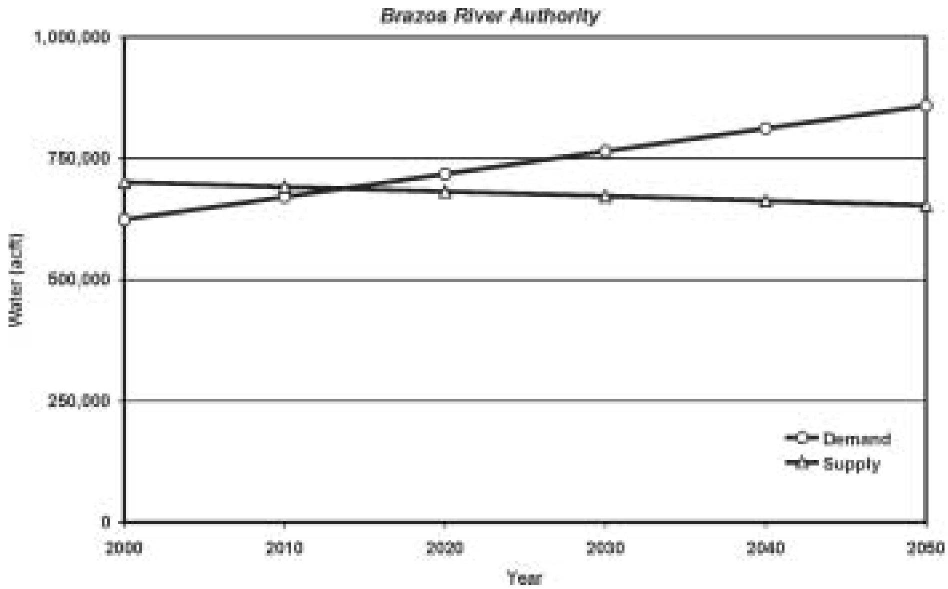
[1] Total supply from BRA System is currently limited to 661,901 acft/yr by TNRCC permits. Use of supplies above this amount would require permit amendments or new permits.

Projected Balance:

	Year (acft)					
	2000	***2010***	***2020***	***2030***	***2040***	***2050***
Balance/(Shortage)	77,375	21,497	(34,381)	(90,259)	(146,137)	(202,014)

Figure 4-1. Major Water Provider Summary — Brazos River Authority

Summary: The BRA System has supply slightly in excess of current long-term water sales contracts. The BRA also makes varying amounts of water (from 4,000 to 50,000 acft, depending on weather conditions) available on a short-term basis. Currently, 35 water supply entities are on the BRA waiting list requesting to purchase more than 235,000 acft/yr. These requests cannot be met from current supplies and this demand creates a projected shortage of 202,014 acft/yr in the planning period.



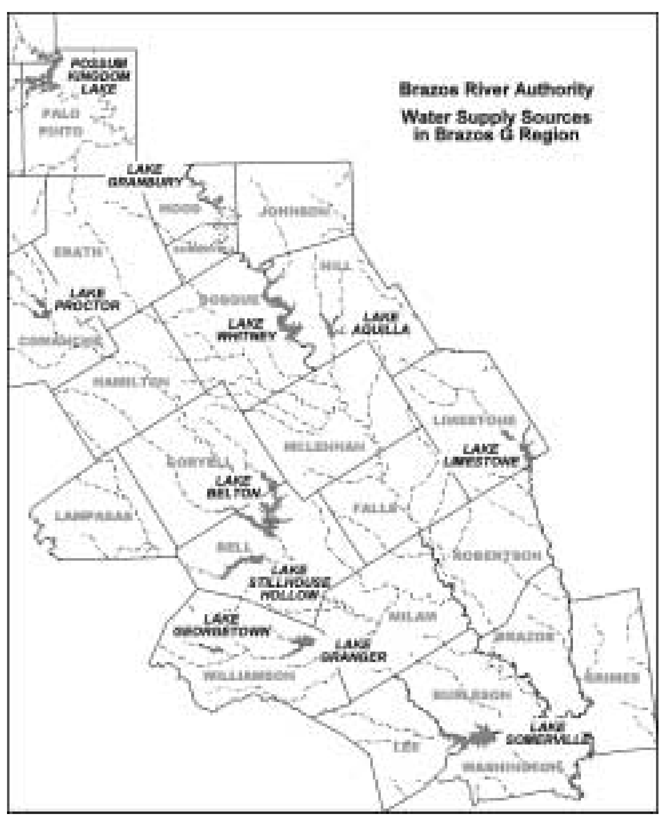


Figure 4-1. Major Water Provider Summary — Brazos River Authority (concluded)

Name/Location: **West Central Texas Municipal Water District (Stevens, Jones, Shackelford, and Taylor Counties)**

Description: The West Central Texas Municipal Water District (MWD) holds water rights in Hubbard Creek Reservoir that authorize it to divert up to 56,000 acft of water per year from the reservoir for municipal, industrial, irrigation, mining, domestic, and livestock use. The District provides raw water to its member cities of Abilene, Albany, Anson, and Breckenridge. The District holds a long-term contract with the Colorado River Municipal Water District (CRMWD) for 16 percent of the yield in O.H. Ivie Reservoir (~15,000 acft) and a supporting contract with the City of Abilene to provide this water to the city.

Projected Demands:

	Year (acft)					
Major Water Contracts	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
City of Abilene	17,362	17,362	17,362	17,362	17,362	17,362
City of Albany	1,882	1,882	1,882	1,882	1,882	1,882
City of Anson	2,061	2,061	2,061	2,061	2,061	2,061
City of Breckenridge	2,487	2,487	2,487	2,487	2,487	2,487
Total Demand	23,792	23,792	23,792	23,792	23,792	23,792

Supply:

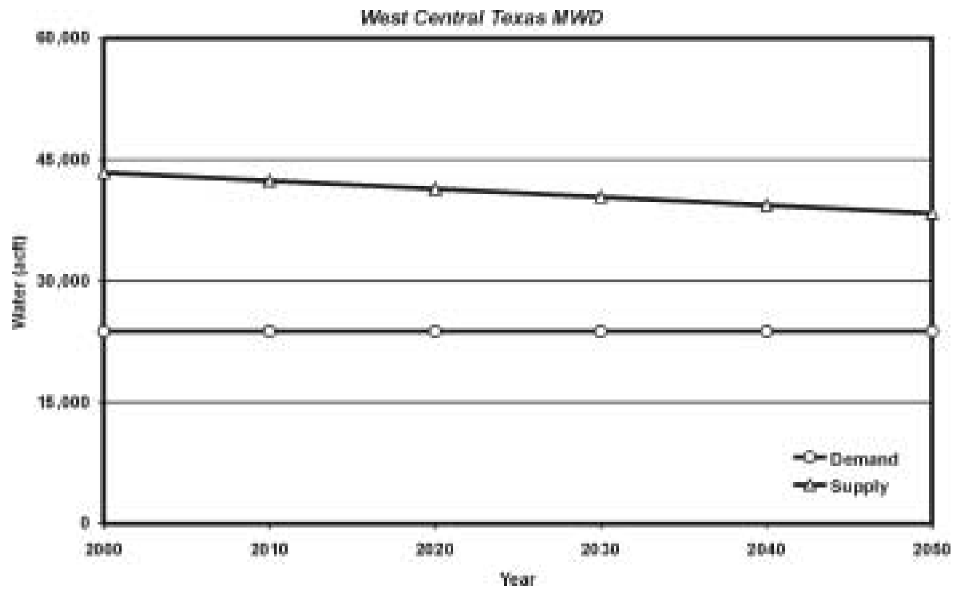
	Year (acft)					
Source	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Hubbard Creek Reservoir (firm yield)	43,399	42,389	41,379	40,369	39,359	38,349
O.H. Ivie Reservoir (contract)	15,000	15,000	15,000	15,000	15,000	15,000

Projected Balance:

	Year (acft)					
	2000	***2010***	***2020***	***2030***	***2040***	***2050***
Balance/(Shortage)	34,607	33,597	32,587	31,577	30,567	29,557

Summary: The West Central Texas MWD has water supply in excess of current contracted demands.

Figure 4-2. Major Water Provider Summary — West Central Texas MWD



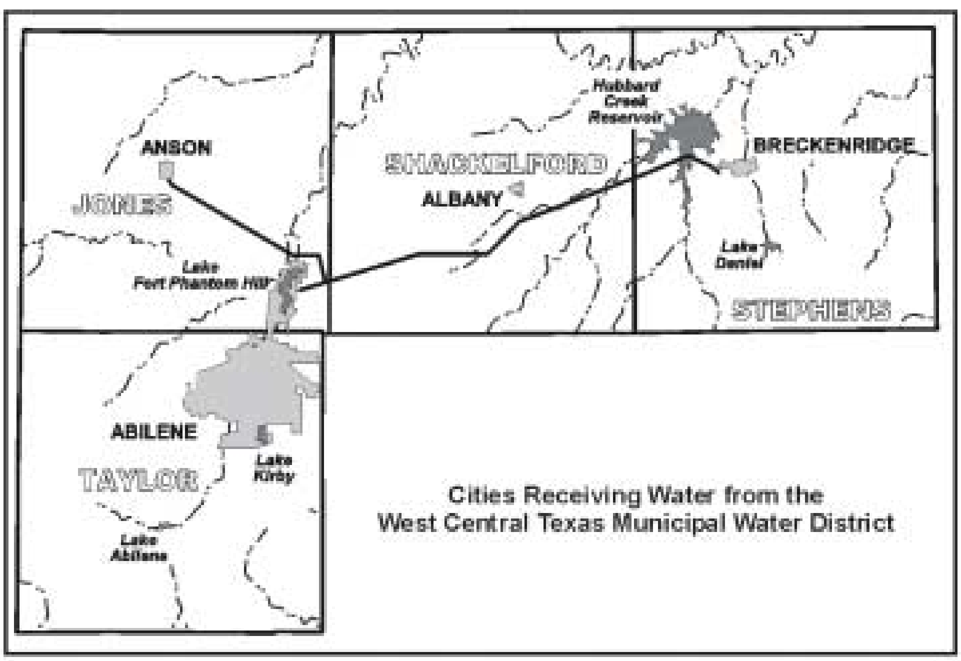


Figure 4-2. Major Water Provider Summary — West Central Texas MWD (concluded)

Name/Location: **City of Abilene (Taylor, Jones, Shackelford, and Callahan Counties)**

Description: The City of Abilene relies on Lakes Fort Phantom Hill, Kirby, and Abilene and water from West Central Texas MWD to meet its needs. The City also has a contract with West Central Texas MWD for ~15,000 acft of O.H Ivie Reservoir, owned by the Colorado River Municipal Water District. The City provides treated water to several other water supply entities in the area.

Projected Demands:

Major Water Contracts	Year (acft)					
	2000	2010	2020	2030	2040	2050
Municipal[1]						
City of Abilene	27,943	30,570	33,768	36,034	38,449	40,015
City of Baird	49	61	73	86	98	110
City of Clyde	57	95	132	170	208	246
City of Merkel	419	397	374	352	329	307
City of Tye	201	183	165	147	129	110
City of Stamford	0	50	123	164	205	246
City of Hamlin	0	100	215	286	358	430
Hamby WSC	357	451	545	639	733	828
Hawley WSC	357	451	545	639	733	828
Potosi WSC	357	451	545	639	733	828
Steamboat Mountain WSC	535	676	818	959	1,100	1,241
Sun WSC	357	451	545	639	733	828
View-Caps WSC	310	423	427	649	762	875
Blair WSC	125	158	191	224	257	290
Fairway Oaks Golf Course	118	118	118	118	118	118
Eula WSC	71	90	109	128	147	166
Industrial[1]						
Coca-Cola Bottling Co. of N. Texas	381	515	649	782	916	1,049
Pride Refining, Inc.	370	500	630	760	890	1,020
U.S. Air Force	1,427	1,929	2,429	2,930	3,430	3,931
West Texas Utilities	1,782	2,226	2,669	3,113	3,556	4,000
Total Demand	35,217	39,895	45,070	49,458	53,884	57,463

[1] These are demands as determined by the City of Abilene and do not necessarily represent contract limits.

Supply:

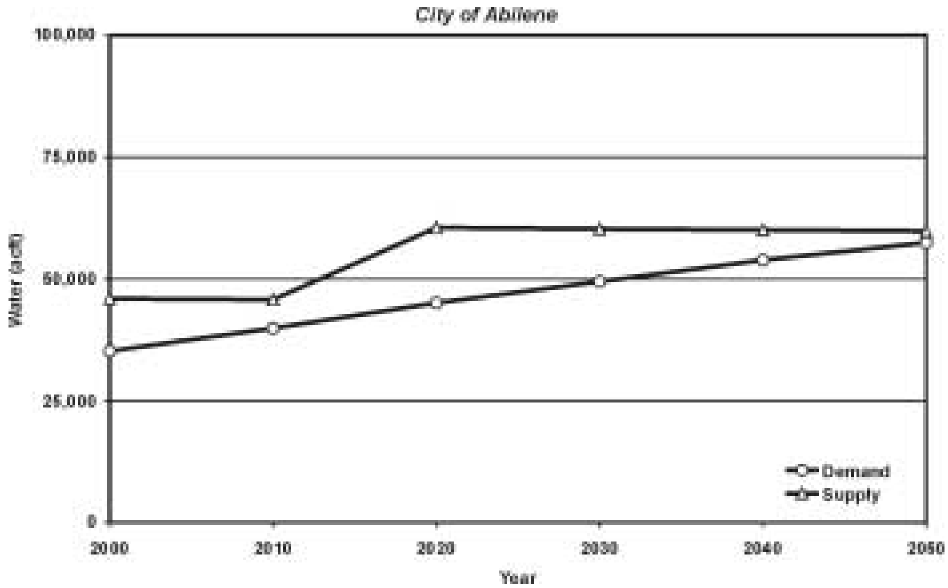
Source	Year (acft)					
	2000	2010	2020	2030	2040	2050
Lake Abilene	1,450	1,384	1,318	1,252	1,186	1,120
Fort Phantom Hill (Municipal)	20,372	20,200	20,028	19,856	19,684	19,512
Fort Phantom Hill (Steam-Electric)	6,500	6,500	6,500	6,500	6,500	6,500
Lake Kirby	300	300	300	300	300	300
Lake O.H. Ivie			15,000	15,000	15,000	15,000
West Central Texas MWD	17,362	17,362	17,362	17,362	17,362	17,362
Total Supply	45,984	45,746	60,508	60,270	60,032	59,794

Projected Balance:

	Year (acft)					
	2000	2010	2020	2030	2040	2050
Balance/(Shortage)	10,768	5,852	15,439	10,812	6,148	2,331

Figure 4-3. Major Water Provider Summary — City of Abilene

Summary: The City of Abilene has water available to meet its contractual commitments through the year 2050.



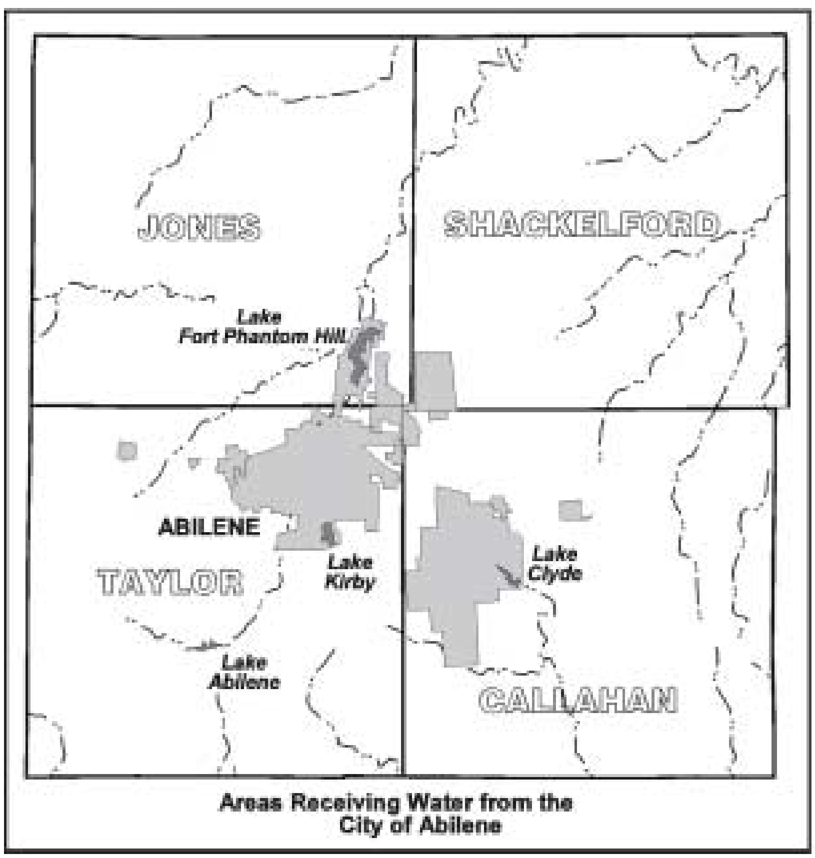


Figure 4-3. Major Water Provider Summary — City of Abilene (concluded)

Name/Location: **City of Waco (McLennan County)**

Description: The City of Waco obtains water from Lake Waco on the Bosque River, and owns water rights to divert 58,200 acft/yr from the lake for municipal use and 900 acft/yr for irrigation. The City is also a party with the Brazos River Authority to divert an additional 20,769 acft from the enlargement of Lake Waco for a total permitted supply of 79,869 acft/yr from Lake Waco. Waco also owns a run-of-the-river water right to divert up to 5,600 acft/yr from the Brazos River, but does not currently use this water right. Waco provides treated water to several water supply entities in the area, as listed below.

Projected Demands:

	Year (acft)					
Major Water Contracts	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Municipal[1]						
City of Waco	27,698	29,880	30,427	33,533	36,778	39,053
City of Hewitt[1]	699	1,326	1,892	2,045	2,088	2,050
City of Lacy-Lakeview[1]	94	126	129	148	160	186
City of Woodway[1]	864	1,164	1,290	1,473	1,638	1,889
City of Bellmead						
Industrial (1996 Use)						
Allergan, Incorporated	138	138	138	138	138	138
Huck International, Inc.	250	250	250	250	250	250
M & M/Mars	444	444	444	444	444	444
Oak Farms Dairy	109	109	109	109	109	109
Owens-Brockway Glass Container	112	112	112	112	112	112
Plantation Foods, Inc.	475	475	475	475	475	475
Waco Reddy Ice	64	64	64	64	64	64
Irrigation	900	900	900	900	900	900
Total Demand	31,847	34,988	36,230	39,691	43,156	45,670

[1] Determined by taking city's projected demand less available supplies from other sources.

Supply:

	Year (acft)					
Source	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Lake Waco[1]	79,870	79,870	79,870	79,870	79,870	79,870
Run-of-River	5,600	5,600	5,600	5,600	5,600	5,600
Total Supply	85,470	85,470	85,470	85,470	85,470	85,470

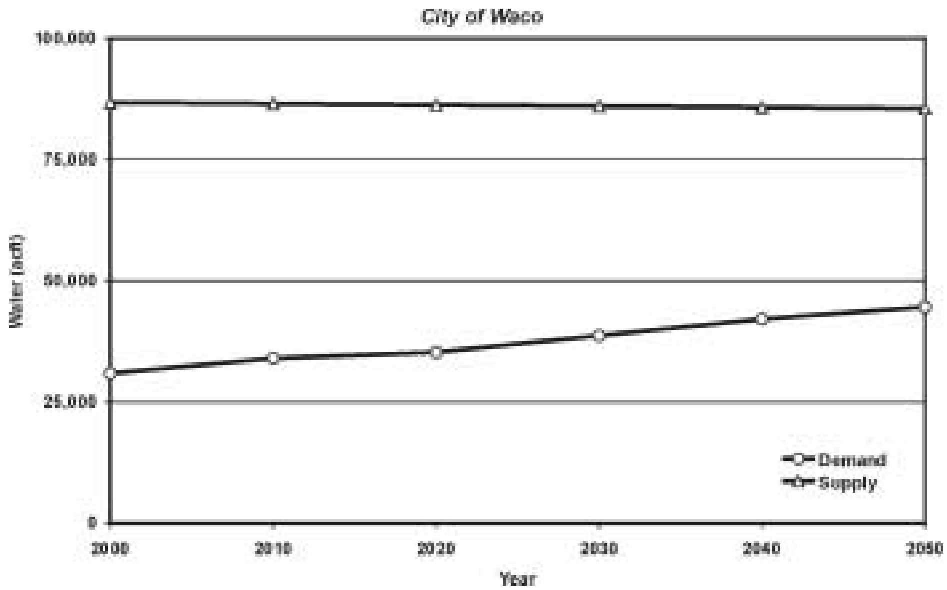
[1] Includes supply available from enlargement of Lake Waco. Infrastructure supply constraints not included.

Projected Balance:

	Year (acft)					
	2000	***2010***	***2020***	***2030***	***2040***	***2050***
Balance/(Shortage)	53,623	50,482	49,240	45,779	42,315	39,800

Summary: The City of Waco has water supply in excess of projected 2050 demands.

Figure 4-4. Major Water Provider Summary — City of Waco



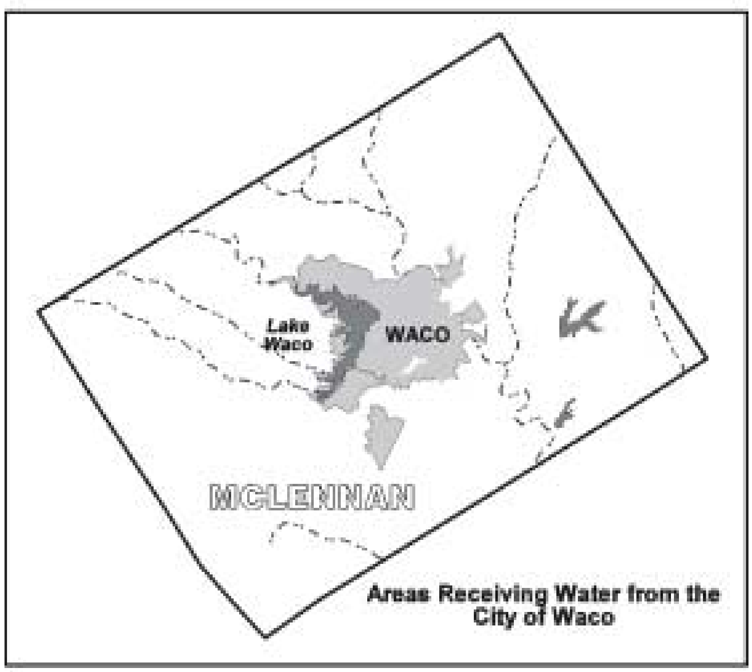


Figure 4-4. Major Water Provider Summary — City of Waco (concluded)

Name/Location: City of Round Rock (Williamson County)

Description: The City of Round Rock obtains its water supply from Lake Stillhouse Hollow, Lake Georgetown, and the Edwards BFZ Aquifer. The City provides several industries and other water supply entities with treated water, as indicated below.

Projected Demands:

	Year (acft)					
Major Water Contracts	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Municipal						
City of Round Rock	13,339	19,672	26,345	30,839	35,318	40,225
Brushy Creek MUD	3,360	0	0	0	0	0
Fern Bluff MUD	393	485	543	572	590	600
Williamson Co. MUD #9	190	230	257	269	278	282
Industrial (1996 Demands)						
Cypress Semiconductor (Tx) Inc.	341	341	341	341	341	341
Dell Computer	133	133	133	133	133	133
Tal/Tex, Inc. (Tonkawa Springs)	171	171	171	171	171	171
Dupont Photomasks, Inc.	40	40	40	40	40	40
Teco-Westinghouse Motor Co.	39	39	39	39	39	39
McNeil Consumer Healthcare	31	31	31	31	31	31
Tellabs, Inc.	21	21	21	21	21	21
TN Technologies, Inc.	7	7	7	7	7	7
Featherlite Building Products, Corp.	5	5	5	5	5	5
Williamson County Water Co. Inc.	2	2	2	2	2	2
Total Demand	18,072	21,177	27,935	32,470	36,976	41,897

Supply:

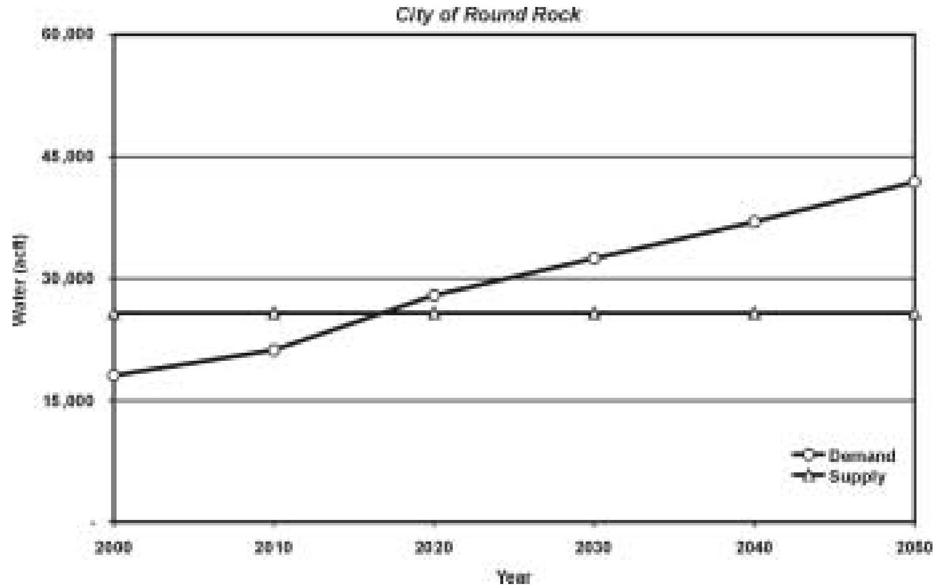
	Year (acft)					
Source	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Lake Georgetown	6,720	6,720	6,720	6,720	6,720	6,720
Lake Stillhouse Hollow	18,134	18,134	18,134	18,134	18,134	18,134
Edwards BFZ (GW)	921	921	921	921	921	921
Total Supply	25,775	25,775	25,775	25,775	25,775	25,775

Projected Balance:

	Year (acft)					
	2000	***2010***	***2020***	***2030***	***2040***	***2050***
Balance/(Shortage)	7,703	4,598	(2,160)	(6,695)	(11,201)	(16,122)

Summary: The City of Round Rock is projected to meet demands through 2010. Starting around 2017, the City of Round Rock is projected to have a shortage of water. By the year 2050, Round Rock will need an additional 16,122 acft of water to meet its demands.

Figure 4-5. Major Water Provider Summary — City of Round Rock



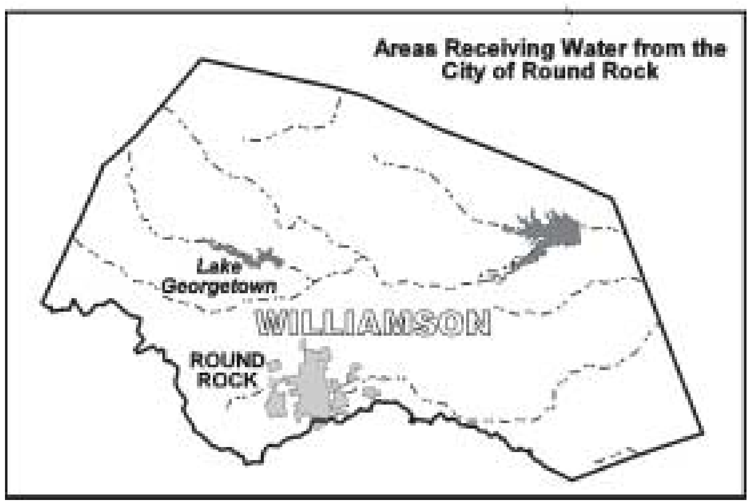


Figure 4-5. Major Water Provider Summary — City of Round Rock (concluded)

Name/Location: **Central Texas Water Supply Corporation (Bell, Falls, Lampasas, Milam, and Williamson Counties)**

Description: The Central Texas Water Supply Corporation (WSC) provides water to a number of water supply corporations and cities in Bell, Williamson, and Lampasas Counties. The Central Texas WSC obtains water under contract with the Brazos River Authority from Lake Stillhouse Hollow.

Projected Demands:

	Year (acft)					
Major Water Contracts	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**
City of Belton	271	271	271	271	271	271
City of Holland	258	258	258	258	258	258
City of Lott	184	184	184	184	184	184
City of Rogers	368	368	368	368	368	368
City of Rosebud	500	500	500	500	500	500
Armstrong Water Supply Corp.	280	280	280	280	280	280
Bell County WCID 5	37	37	37	37	37	37
Bell-Milam-Falls W.S.C.	446	446	446	446	446	446
Dog Ridge WSC	671	671	671	671	671	671
East Bell Co. WSC	341	341	341	341	341	341
Kempner WSC	3,500	3,500	3,500	3,500	3,500	3,500
Little Elm Valley WSC	147	147	147	147	147	147
Town of Buckholts-Water Dept.	174	174	174	174	174	174
Town of Oenaville And Belfalls	57	57	57	57	57	57
West Bell County WSC	921	921	921	921	921	921
Westphalia WSC	45	45	45	45	45	45
Total Demand	8,200	8,200	8,200	8,200	8,200	8,200

Supply:

	Year (acft)					
Source	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**
BRA Contract (Stillhouse)	14,045	14,045	14,045	14,045	14,045	14,045

Projected Balance:

	Year (acft)					
	2000	**2010**	**2020**	**2030**	**2040**	**2050**
Balance/(Shortage)	5,845	5,845	5,845	5,845	5,845	5,845

Summary: The Central Texas WSC has water supply in excess of projected 2050 demands.

Figure 4-6. Major Water Provider Summary — Central Texas WSC

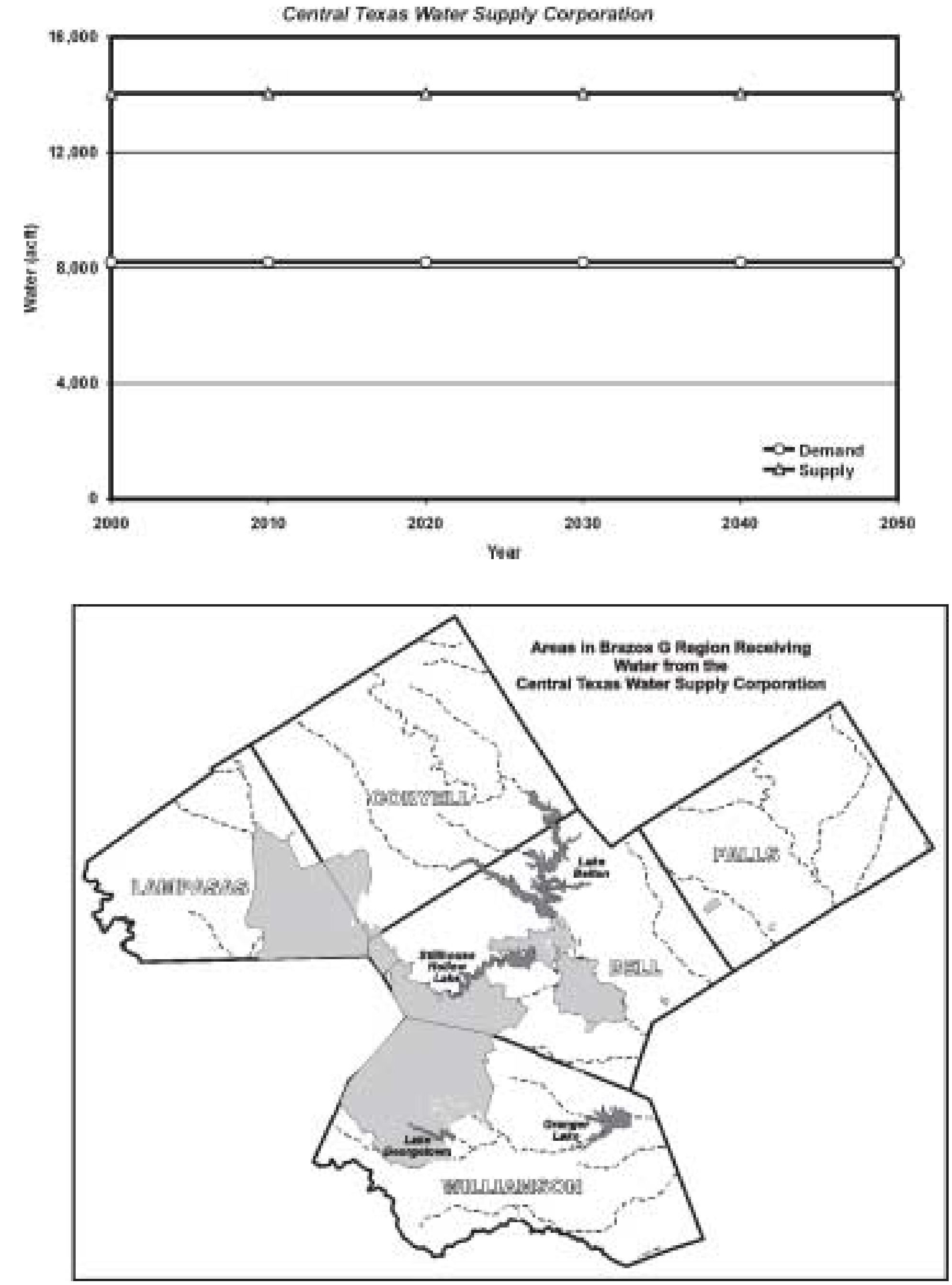


Figure 4-6. Major Water Provider Summary — Central Texas WSC (concluded)

Name/Location: **Bell County Water Control and Improvement District No.1 (Bell and Coryell Counties)**

Description: Bell County Water Control and Improvement District (WCID) No. 1 obtains all of its water from Lake Belton by a contract with the Brazos River Authority for 49,509 acft/yr. Bell County WCID No. 1 also provides treated water to several other water supply entities in the region, as listed below.

Projected Demands:

Major Water Contracts	Year (acft)					
	2000	2010	2020	2030	2040	2050
City of Belton	4,966	4,966	4,966	4,966	4,966	4,966
City of Copperas Cove	7,824	7,824	7,824	7,824	7,824	7,824
City of Harker Heights	5,265	5,265	5,265	5,265	5,265	5,265
City of Killeen	29,964	29,964	29,964	29,964	29,964	29,964
City of Nolanville (Bell Co. WCID No. 3)	740	740	740	740	740	740
439 Water Supply Corp	750	750	750	750	750	750
Total Demand	49,509	49,509	49,509	49,509	49,509	49,509

Supply:

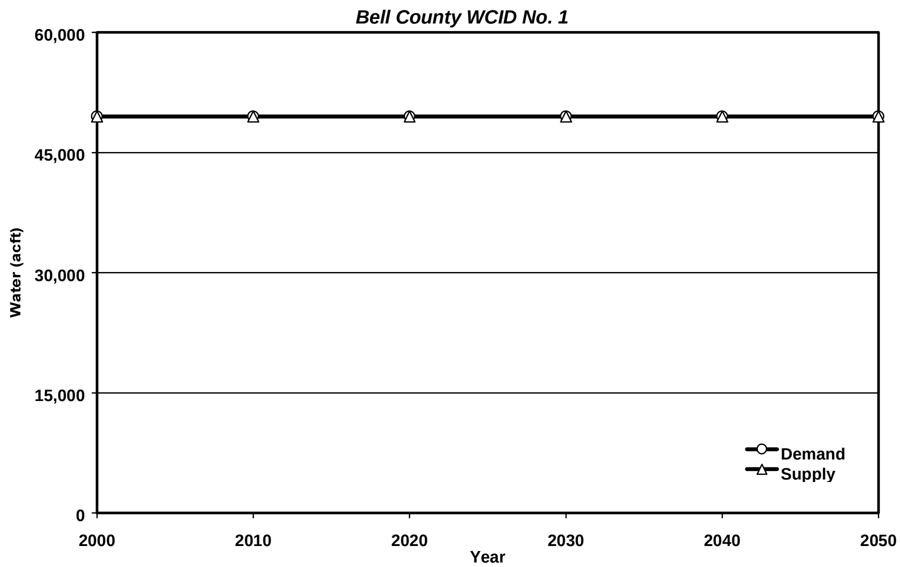
Source	Year (acft)					
	2000	2010	2020	2030	2040	2050
BRA Contract (Belton)	49,509	49,509	49,509	49,509	49,509	49,509

Projected Balance:

	Year (acft)					
	2000	2010	2020	2030	2040	2050
Balance/(Shortage)	0	0	0	0	0	0

Summary: Bell County WCID No. 1 has water supply to meet its contract obligations.

Figure 4-7. Major Water Provider Summary — Bell County WCID No. 1



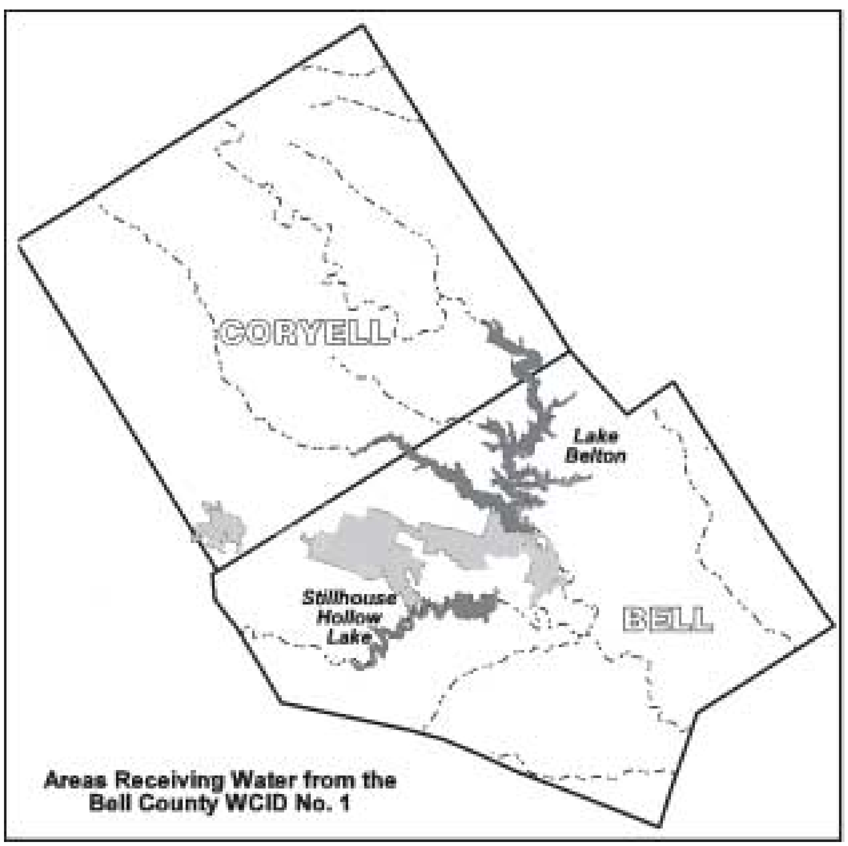


Figure 4-7. Major Water Provider Summary — Bell County WCID No. 1 (concluded)

Name/Location: **Lower Colorado River Authority (LCRA)**

Description: The LCRA is a conservation and reclamation district created by the Legislature of the State of Texas in 1934. The LCRA operates six reservoirs on the Colorado River, south of the Brazos G Planning Region. The LCRA sells water for municipal, irrigation, and industrial use in the Colorado River Basin and portions of Williamson County and Lampasas County in the Brazos G Planning Region. The LCRA and the irrigation companies it owns also export water out of the Basin to areas in the Brazos-Colorado Coastal Basin, the Colorado-Lavaca Coastal Basin, and the Lavaca River Basin. The City of Austin obtains water from LCRA and supplies part of Williamson County, although the city of Austin service area is not in the Brazos G Region.

Projected Demands:

	Year (acft)					
Major Water Contracts	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
City of Cedar Park	16,500	16,500	16,500	16,500	16,500	16,500
City of Leander	6,400	6,400	6,400	6,400	6,400	6,400
City of Lometa	450	450	450	450	450	450
BRA/LCRA Alliance[1]	25,000	25,000	25,000	25,000	25,000	25,000
Total Demand	48,350	48,350	48,350	48,350	48,350	48,350

[1] BRA/LCRA Alliance is going to contract with LCRA to purchase 25,000 acft/yr from the Highland Lakes, as allowed by HB 1437.

Supply:

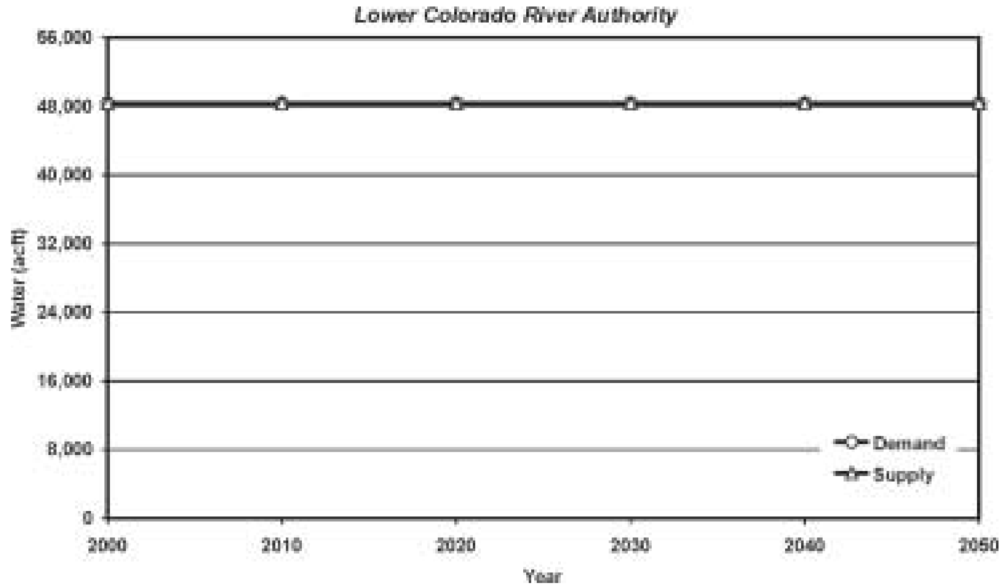
	Year (acft)					
Source	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Highland Lakes	48,350	48,350	48,350	48,350	48,350	48,350

Projected Balance:

	Year (acft)					
	2000	***2010***	***2020***	***2030***	***2040***	***2050***
Balance/(Shortage)	0	0	0	0	0	0

Summary: The LCRA has water supply available to meet contractual commitments in the Brazos G Region through 2050.

Figure 4-8. Major Water Provider Summary — LCRA



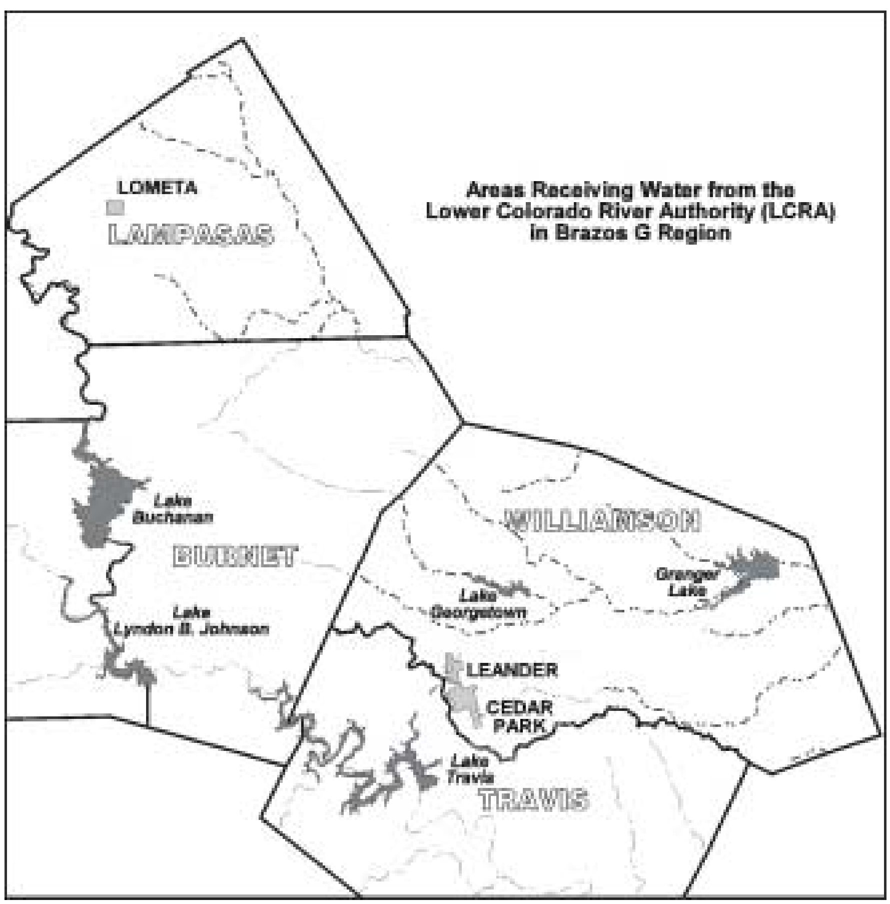


Figure 4-8. Major Water Provider Summary — LCRA (concluded)

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4.4 Special Water Resources

Existing water rights and water supply contracts supplied from special water resources are to be honored by each regional planning group when developing water plans. To this end, and to provide a tool by which the Brazos G Region can coordinate water supplies leaving or entering the region, a table of water contracts existing at each special water resource in Brazos G was prepared. These tables were submitted for review and comment to the consultant for each regional planning group that receives water from the resource.

Eleven of the 27 reservoirs named as special water resources by TWDB are located in the Brazos G Region and all of these eleven are Brazos River Authority system reservoirs.[1] The eleven BRA reservoirs are grouped together into a single summary table (Table 4.4-1). The other special water resources supply water into the Brazos G Region. Those reservoirs and their respective summary tables are: Lake Travis in Region K (Table 4.4-2); Oak Creek Reservoir in Region F (Table 4.4-3); and O.H. Ivie Reservoir in Region F (Table 4.4-4). In addition to these reservoirs named by TWDB, three additional reservoirs have been identified supplying water into or out of the Brazos G Region and are also summarized here. These additional special water resources are Miller's Creek Reservoir located in Region B (Table 4.4-5); Navarro Mills Reservoir located in Region C (Table 4.4-6); and Palo Pinto Reservoir located in Brazos G and provides water to Region C (Table 4.4-7).

[1] The 11 special water resource reservoirs in the Brazos River Authority system are: Possum Kingdom, Granbury, Whitney, Aquilla, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Somerville, and Limestone.

Table 4.4-1.
Special Water Resource Summary for BRA Reservoirs

The following table summarizes supply and demand of the Brazos River Authority's reservoirs named as Special Water Resources. The reservoirs included in this table include Aquilla, Belton, Georgetown, Granbury, Granger, Limestone, Possum Kingdom, Proctor, Somerville, Stillhouse, and Whitney. This summary is used to coordinate water supply from Brazos G used in Region H, Region C, and Region O.

Owner: Brazos River Authority

BRA Reservoirs	***2000 (acft)***	***2030 (acft)***	***2050 (acft)***
Permitted Diversion	661,901	661,901	661,901
Firm Yield[1]	703,106	675,273	656,717
Major Long-term Contract Holders		***Contract Amounts***	
In Region G			
Long-term Contracts	493,876	476,862	458,400
In Region H			
Dow Pipeline[2]	16,000	16,000	16,000
Gulf Coast Water Authority[2]	32,668	9,335	9,335
HL&P[2]	83,000	83,000	0
South Texas Water Co.[2]	5,625	0	0
In Region O			
City of Lubbock[2]	961	961	961
In Region C			
Vulcan Materials Co.[2]	35	35	35
Total Surface Water Supply from BRA System			
Region G	493,876	476,862	458,400
Region H	137,293	108,335	25,335
Region O	961	961	961
Region C	35	35	35
Grand Total	**632,165**	**586,193**	**484,731**

[1] Firm Yields from Brazos River Authority for SB1 Planning Study

[2] Contract amounts shown include expirations. Some contracts may have renewal agreements, this table does not reflect those renewals

Table 4.4-2.
Special Water Resource Summary for Highland Lakes

The following table of the LCRA Highland Lake System includes diversions from Lake Travis. Lake Travis is located in Region K.

Owner: Lower Colorado River Authority

LCRA Highland Lakes (Lake Travis)	***2000 (acft)***	***2030 (acft)***	***2050 (acft)***
Permitted Diversion	1,500,000	1,500,000	1,500,000
Firm Yield[1]	445,766	445,766	445,766
Major Long-term Contract Holders		***Contract Amounts***	
In Region G			
City of Cedar Park	16,500	16,500	16,500
City of Leander[2]	6,400	6,400	6,400
City of Lometa[2]	450	450	450
City of Round Rock (from City of Austin)	5,376	0	0
BRA/LCRA Alliance (HB 1437)[3]	25,000	25,000	25,000
In Region K			
Contracts and Other Commitments[4]	392,040	397,416	397,416
Total Surface Water Supply from LCRA Highland Lakes			
Region G	53,726	48,350	48,350
Region K	392,040	397,416	397,416
Grand Total	**445,766**	**445,766**	**445,766**

[1] Firm Yield from LCRA for SB1 Planning Study
[2] Committed by LCRA Board resolution
[3] Pending
[4] The remainder of the LCRA Highland Lakes Supply remains in Region K

Table 4.4-3.
Special Water Resource Summary for Oak Creek Reservoir

Oak Creek Reservoir is located within Region F

Owner: City of Sweetwater

Oak Creek Reservoir	*2000 (acft)*	*2030 (acft)*	*2050 (acft)*
Permitted Diversion	10,000	10,000	10,000
Firm Yield[1]	5,684	5,266	4,987
Major Long-term Contract Holders		***Contract Amounts***	
In Region G			
Bitter Creek WSC[2]	460	0	0
City of Roby[2]	350		
City of Roscoe[2]	560	560	560
City of Trent[2]	187	0	0
City of Sweetwater	2,520	3,234	3,755
In Region F			
City of Blackwell[2]	168	168	168
City of Bronte[2]	504	504	504
West Texas Utilities[2]	800	800	0
Fort Chadborne Ranch[2]	135		
Total Surface Water Supply from Oak Creek Reservoir			
Region G	4,077	3,794	4,315
Region F	1,607	1,472	672
Grand Total	**5,684**	**5,266**	**4,987**

1 Firm yields estimated by Freese and Nichols as part of the SB1 Region F Planning Study.
2 Water supplied by the City of Sweetwater

Table 4.4-4.
Special Water Resource Summary for O.H. Ivie Reservoir

O.H. Ivie is located in Region F

Owner: Colorado River MWD

OH Ivie Reservoir[1]	***2000 (acft)***	***2030 (acft)***	***2050 (acft)***
Permitted Diversion	113,000	113,000	113,000
Firm Yield[2]	96,169	93,397	91,830
Major Long-term Contract Holders		***Contract Amounts***	
In Region G			
City of Abilene	15,000	15,000	15,000
In Region F			
City of Midland	15,000	15,000	15,000
City of San Angelo	15,000	15,000	15,000
Total Surface Water Supply from OH Ivie Reservoir			
Region G	15,000	15,000	15,000
Region F	30,000	30,000	30,000
Grand Total	**45,000**	**45,000**	**45,000**

[1] All CRMWD contracts are based on safe yields
[2] Firm yields estimated by Freese and Nichols as part of the SB1 Region F Planning Study

Table 4.4-5.
Special Water Resource Summary for Miller's Creek Reservoir

Miller's Creek is located in Region B

Owner: North Central Texas MWD

Miller's Creek Reservoir	***2000 (acft)***	***2030 (acft)***	***2050 (acft)***
Permitted Diversion	5,000	5,000	5,000
Firm Yield[1]	3,100	2,460	2,034
Major Long-term Contract Holders	***Contract Amounts***		
In Region G			
City of Aspermont	93		
City of Benjamin	8		
City of Goree	63		
City of Haskell	504		
City of Knox City	267		
City of Munday	281		
City of O'Brien	6		
City of Rochester	13		
City of Rule	30		
Paint Creek WSC	54		
Total Surface Water Supply from Miller's Creek Reservoir			
Region G	1,319	0	0
Grand Total	**1,319**	**0**	**0**

[1] Firm Yield from 1990 TWDB State Water Plan

Table 4.4-6.
Special Water Resource Summary for Navarro Mills Reservoir

Navarro Mills is located in Region C

Owner: Trinity River Authority

Navarro Mills Reservoir	***2000 (acft)***	***2030 (acft)***	***2050 (acft)***
Permitted Diversion	19,400	19,400	19,400
Firm Yield[1]	22,900	19,400	19,130
Major Long-term Contract Holders	***Contract Amounts***		
In Region G			
Post Oak WSC[2]	353	353	353
In Region C			
Corsicana[3]	17,460	17,460	17,460
Dawson	368	368	368
Texas Industries	450	450	450
Total Surface Water Supply from Navarro Mills Reservoir			
Region G	353	353	353
Region C	18,278	18,278	18,278
Grand Total	**18,631**	**18,631**	**18,631**

1 Firm Yield from Freese and Nichols for SB1 Water Planning Study (see Region C TWDB Table 4)
2 53 acft/yr is estimated to supply users in Region C
3 Corsicana sells 207 acft/yr to the City of Hubbard in Region G

Table 4.4-7.
Special Water Resource Summary for Palo Pinto Reservoir

Lake Palo Pinto is located in Region G

Owner: Palo Pinto MWD No. 1

Lake Palo Pinto	2000 (acft)	2030 (acft)	2050 (acft)
Permitted Diversion	18,500	18,500	18,500
Firm Yield[1]	14,560	13,164	12,233
Major Long-term Contract Holders		***Contract Amounts***	
In Region G			
City of Mineral Wells	2,924	3,402	3,402
Parker County WSC	294	0	0
In Region C			
Millsap WSC	184	0	0
Region C County Other	0	144	164
Total Surface Water Supply from Lake Palo Pinto			
Region G	3,218	3,402	3,402
Region C	184	144	164
Grand Total	**3,402**	**3,546**	**3,566**

[1] Firm Yield estimated by HDR for Palo Pinto MWD No. 1 in a report titled "Yield Studies of Lake Palo Pinto and Turkey Peak Reservoir Sites."

4.5 Projected Water Shortages

The large amount of information presented in Section 4.2 (County Summaries) and Section 4.3 (Major Water Providers) has been reviewed for projected shortages. The following sections summarize that information as follows:

1. Municipal Use Category – Section 4.5.1:
   - Incorporated cities and County-Other category projected to have water shortages.
   - Entities reporting water supply concerns.
   - Rural water supply entities in counties projected to have water shortages or where County-Other category is projected to have water shortages.
2. Counties showing projected Manufacturing Use projected shortages – Section 4.5.2.
3. Counties showing projected Steam-Electric Use projected shortages – Section 4.5.3.
4. Counties showing projected Mining Use projected shortages – Section 4.5.4.
5. Agricultural Water Demand and Supply - Section 4.5.5.
6. Counties showing projected Livestock Use projected shortages – Section 4.5.6.

4.5.1 Projected Municipal Shortages

4.5.1.1 Cities with Projected Shortages

The information presented in Sections 4.2.1 through 4.2.37 was reviewed for cities projected to have water shortages. Those water-short cities are listed in Table 4-75 and mapped in Figure 4-9. Table 4-75 also reports the projected year 2030 and 2050 shortage, and the approximate year that shortages would begin for each water-short city.

4.5.1.2 County-Other Projected Shortages

The County-Other category includes water supply corporations, water districts, privately owned utilities, small towns (less than 500 population), parks, federal and state institutions, and other entities. The county summary demand/supply tables (Tables 4-1 through 4-74) indicate nine counties where the County-Other category as a whole is projected to be water short. Those counties are Bosque, Coryell, Johnson, Jones, McLennan, Nolan, Somervell, Throckmorton, and Williamson. Sections 4.5.1.2.1 through 4.5.1.2.9 list the public water supply entities within these counties.

Table 4-75.
Cities with Projected Water Shortages

County	Shortages Begin Prior To:	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Bell County			
Fort Hood	2000	(3,098)	(3,098)
Holland	2020	(87)	(94)
Little River-Academy	2020	(127)	(124)
Morgans Point Resort	2000	(584)	(648)
Salado WSC	2020	(228)	(478)
Troy	2000	(255)	(274)
Bosque County			
Meridian	2000	(218)	(281)
Valley Mills	2000	(77)	(83)
Walnut Springs	2000	(41)	(43)
County-Other	2000	(992)	(1,194)
Brazos County			
Bryan	2040	0	(3,106)
College Station	2010	(6,381)	(12,295)
Burleson County			
None			
Callahan County			
Baird	2000	(149)	(118)
Comanche County			
None			
Coryell County			
Copperas Cove	2030	(426)	(3,296)
Fort Hood	2000	(2,365)	(2,261)
Gatesville	2020	(6,102)	(8,121)
County-Other	2000	(541)	(437)
Eastland County			
Cisco	2000	(185)	(119)
Eastland	2040	0	(875)
Ranger	2040	0	(460)
Erath County			
Stephenville	2000	(1,538)	(1,899)
Falls County			
None			
Fisher County			
Roby	2030	(54)	(48)
Grimes County			
None			

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Table 4-75 (continued)

County	Shortages Begin Prior To:	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Hamilton County			
None			
Haskell County			
Haskell	2000	(526)	(538)
Hill County			
None			
Hood County			
Granbury	2010	(2,905)	(3,835)
Johnson County			
Alvarado	2020	(72)	(220)
Briar Oaks	2000	(36)	(38)
Burleson (P)	2010	(783)	(1,544)
Cleburne	2040	0	(2,822)
Godley	2000	(60)	(60)
Grandview	2000	(160)	(190)
Joshua	2030	(29)	(209)
Keene	2000	(1,149)	(1,495)
Rio Vista	2000	(34)	(36)
County-Other	2000	(7,377)	(9,464)
Jones County			
Hamlin	2000	(53)	(105)
Stamford	2000	(748)	(959)
County-Other	2000	(93)	(88)
Kent County			
None			
Knox County			
Knox City	2020	(235)	(235)
Munday	2000	(294)	(295)
Lampasas County			
Lampasas	2020	(544)	(1,501)
Lee County			
Giddings	2000	(337)	(542)
Limestone County			
Groesbeck	2000	(756)	(874)
McLennan County			
McGregor	2000	(313)	(360)
Robinson	2000	(551)	(615)
West	2000	(399)	(378)
County-Other	2000	(4,029)	(3,785)
Milam County			
Rockdale	2050	0	(30)

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Table 4-75 (continued)

County	Shortages Begin Prior To:	Projected Shortages (acft/yr) Year 2030	Year 2050
Nolan County			
County-Other	2020	(155)	(89)
Palo Pinto County			
Palo Pinto	2010	(82)	(83)
Robertson County			
Hearne	2030	(67)	(290)
Shackelford County			
None			
Somervell County			
Glen Rose	2000	(300)	(432)
County-Other	2000	(734)	(1,282)
Stephens County			
None			
Stonewall County			
None			
Taylor County			
Abilene	2020	(2,610)	(7,067)
Merkel	2000	(294)	(355)
Throckmorton County			
Throckmorton	2000	(158)	(140)
County-Other	2000	(50)	(43)
Washington County			
None			
Williamson County			
Brushy Creek	2010	(4,020)	(3,887)
Florence	2010	(136)	(212)
Georgetown	2010	(8,151)	(18,535)
Granger	2010	(129)	(224)
Hutto	2010	(265)	(550)
Leander	2050	0	(171)
Round Rock	2010	(12,157)	(21,543)
Taylor	2040	0	(1,507)
Thrall	2010	(40)	(63)
County-Other	2000	(11,750)	(11,302)
Young County			
None			
Number of cities on list: 58	Number of County-Others: 9		Total: 67
(P) Indicates city is in multiple counties.			

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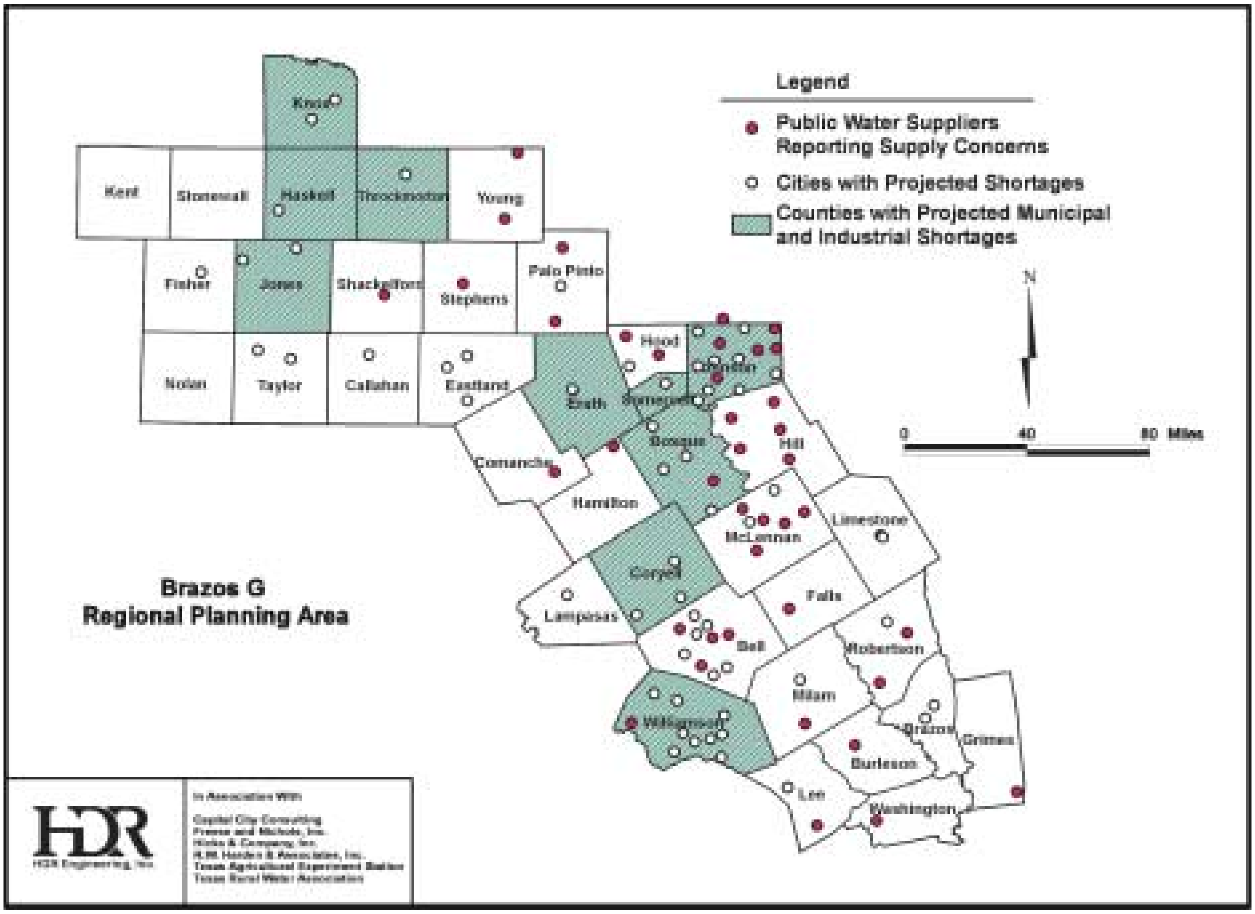

Figure 4-9. Projected Municipal Water Shortages and Entities Reporting Water Supply Concerns

4.5.1.2.1 Bosque County Entities in County-Other Category

Demand/supply projections for Bosque County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Aqua Pure Water Supply
- Bosque-Brazos Valley Water Supply
- Camelot Estates Water Supply
- Cedar Shores Estates Water Corp.
- Cedron Creek Ranch, Inc.
- Childress Creek WSC
- City of Cranfills Gap
- City of Iredell
- City of Morgan
- Kopperl ISD
- Lake Whitney Water Co., Inc.
- Lakeline Acres Water Co.
- Lakeside Water Supply District
- Lakewood Harbor
- Lame Duck Water System
- Mermaid Swimming Pool
- Mosheim WSC.
- Mustang Valley WSC

- Cliff Oaks Addition
- Cooney Cavern Lodge
- Glenshores Water System
- Highland Park Water Corp.
- Highlands Water Co.
- Hog Creek WSC
- Indian Lodge Water System
- Prairie Oaks Water Co.
- Shuler Point Water System
- Smith Bend WSC
- Smith Bend WSC
- Steele Creek Harbor Water Supply
- Texas Parks & Wildlife Dept.
- U. S. Corps of Engineers

4.5.1.2.2 Coryell County Entities in County-Other Category

Demand/supply projections for Coryell County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Amspachers Grocery & Station
- Bluestem Estates
- Cedar Grove Mfg. Home Community
- City of Copperas Cove
- City of Gatesville
- Coryell City Water Supply District
- Duren Village Multi-County WSC
- Elm Creek Water Supply Corporation
- Flat Water Supply Corporation
- North Fort Hood
- The Grove Water Supply Corporation
- Leon Junction Water Supply Corporation
- Mosheim Water Supply Corporation
- Mountain Water Supply Corporation
- Oglesby Water Supply Corporation
- Sun Set Estates
- Topsey Water Supply Corporation
- Whispering Oaks Subd. Water Supply

4.5.1.2.3 Johnson County Entities in County-Other Category

Demand/supply projections for Johnson County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- A & A Mobile Home Park
- Ace Mobile Home Park
- Bethesda WSC
- Blue Water Oaks
- Burleson Oaks Estates
- Chuck Bell Water Co.
- City of Venus
- Clearview Drive Water System
- Community of Bethany
- Community Water & Sewer Corp.
- Crest Water Co.
- Oakview Farms Subdivision Water System
- Parker WSC
- Peaceful Meadows Subdivision
- Primrose Water System
- Rancho Villa Estates
- Ridge Crest Addition
- Shaded Lane Estates
- Shady Hill Estates
- Shady Lane Water Co.
- Shady Meadows Estate
- Shorty's Mobile Home Village

- Crowley 1 Acre - Sky Corp Water Co.
- Crowley Two Acre Water Co.
- G & H Management, Inc.
- Garden Acres System
- Granda Vista & Oakview Village
- Hilltop Water
- Johnson County FWSD 1
- Johnson County Rural WSC
- Lark Meadow Subdivision
- Mansfield South
- Metroplex Homesteads Water System
- Mockingbird Hill Mobile Home Park
- Mountain Peak WSC
- Mountainaire Mobile Home Park
- Mountainview Estates
- Northcrest-Burleson Oaks
- Oak Leaf Trail Subdivision
- Oak Ridge Subdivision
- Oakridge Square Mobile Home Park
- Skyline Drive Landowners Assn.
- Skyline Ranch
- Spring Valley Water Co-op.
- Stonefield Water System
- Summit Ridge Estates
- Sundance Addition
- Sunset Canyon
- Sunset Canyon Water Company
- Sunshine Country Acres
- Texas Parks & Wildlife Dept.
- Thomas Acres
- Three B Farms, Inc. Water System
- Union Hill Water System
- Walden Estates Water Co
- West Lakeview Water Supply Co-op
- Whispering Meadows Water System
- Williams Mobile Home Park
- Willow Bend Subdivision
- Woodland Oaks Estates

4.5.1.2.4 Jones County Entities in County-Other Category

Demand/supply projections for Jones County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- City of Lueders
- Ericksdahl WSC
- Hawley WSC

4.5.1.2.5 McLennan County Entities in County-Other Category

Demand/supply projections for McLennan County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Axtell WSC
- Behringer Water System
- Bold Springs WSC
- Bosque Basin WSC
- Bosqueville Green Acres WSC
- Midway ISD
- Moore's Water System
- Moses Hill Estates
- M-S WSC
- North Bosque WSC

- C S WSC
- Cedar Ridge Deep Well Water
- Central Bosque WSC
- Chalk Bluff WSC
- China Spings Water Co.
- Community Springs Water Co.
- Cottonwood WSC
- Country Aire Water System
- Cross Country WSC
- Driskell Suburban Mobile Estates
- Eagle Canyon Water Works
- East Crawfod WSC
- Elk-Oak Lake WSC
- Elm Creek WSC
- Faltrock Water Co.
- Gholson WSC
- Goodall Water System
- HYB Water Supply
- H and H WSC
- Harris Creek Water Co.
- Hilltop WSC
- Lake Waco Country Club
- Leroy-Tours-Gerald WSC
- Levi WSC
- McLennan Co. WCID No. 2
- North County Water Supply
- Ostrom Water Co.
- Patrick WSC
- Pure Water Supply Corp.
- Pure Water Supply Corp.
- Pure Water Supply Corp.
- Pure Water Supply Corp.
- R K S Water Co., Inc.
- R.M.S. WSC
- Rivercrest Water Co. – Brune
- Rock Creek Water Supply, Inc.
- Rolling Hills Country Club
- Ross WSC
- Smith Water Co., Inc.
- South Bosque WSC
- Spring Valley WSC
- Town of Axtell
- Tubbs Water System
- Twin Bayou WSC
- Valley Mills High School
- Valley View Water Co.
- Wester Hills Water System
- Westlake Water System, Inc.
- Windsor Water Co.

4.5.1.2.6 Nolan County Entities in County-Other Category

Demand/supply projections for Nolan County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Bitter Creek Water Supply Corp.
- Blair Water Supply Corp.
- City of Roscoe
- City of Sweetwater
- City of Trent
- Nolan Co. FWSD #1

4.5.1.2.7 Somervell County Entities in County-Other Category

Demand/supply projections for Somervell County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Happy Hill Farm Water Supply
- Oak River Ranch
- Riverside Mobile Home Park
- Scruggs Mobile Home Park
- Squaw Creek Subdivision Water Supply
- Sunset Park Water System
- Texas Parks & Wildlife Dept.
- Young Women's Christian Assoc.

4.5.1.2.8 Throckmorton County Entities in County-Other Category

Demand/supply projections for Throckmorton County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Town of Woodson

4.5.1.2.9 Williamson County Entities in County-Other Category

Demand/supply projections for Williamson County indicate that the County-Other category will be water short (Table 4-75). The water supply entities potentially affected by shortages are:

- Blessing Mobile Home Park
- Blockhouse MUD
- Carriage Oaks Water System
- Cedar Park MUD 1
- Chandler Creek MUD
- Chaparral III
- Chisholm Trail Special Utility District
- City of Andice
- City of Weir
- Clearview Water District
- Durham Park WSC
- Fern Bluff MUD
- Green Acres Water Supply
- High Gabriel WSC
- Inner Space Cavern
- Liberty Hill WSC
- Manville WSC
- Meridell Achievement Center, Inc.
- Noack WSC
- Rays Retirement Village
- Round Rock WSC
- San Gabriel River Ranches
- South San Gabriel River Ranches
- Southern Hills WSC
- Springwoods MUD
- Tal/Tex, Inc. (Great Oaks)
- Tal/Tex, Inc. (Tonkawa Springs)
- Walburg Water Supply
- Williamson County MUD 3
- Williamson County MUD 5

- Jarrell-Schwertner WSC
- Jenks Brank WSC
- Jonah Water
- Lake Granger WSC
- Williamson County MUD 6
- Williamson County MUD 9
- Williamson County Water Co., Inc.
- Williamson-Travis MUD 1

4.5.1.3 Entities Reporting Water Supply Concerns

In June of 1998, surveys were mailed to all public water supply entities (about 800 entities) in the Brazos G region. These entities included cities, water supply corporations, water districts, private water companies, institutions, and others. The purpose of the survey was to obtain input regarding water supply and water infrastructure concerns. The survey included these questions:

1. Do you anticipate any problems in meeting your customer's water demands during this current dry period?
2. Are you currently limiting customer water use (by voluntary conservation or other means) to avoid water shortages?
3. Is your utility listed by TNRCC as an E (emergency), P (priority), or W (watch) water system and requiring water use limitations?
4. Do you anticipate any water supply problems within the next four years?
5. If you answered "yes" to any of the above, is the water supply problem related to your raw water supply, or to the capacity of your treatment and distribution system?
6. Are you under any compliance orders from TNRCC?

Of the approximately 800 surveys mailed, 335 responses were received. Out of the responses received, 69 of the entities answered "yes" to Question 4, thereby indicating a concern regarding their water supply. Table 4-76 lists the entities responding to Question 4 and whether their response is related to raw water supply or treatment and distribution. Fifty-six (56) of the responses had a concern with raw water supply, 10 were concerned with treatment and distribution, and 3 were concerned with both raw water and treatment/distribution. The locations of the entities responding to Question 4 are plotted on Figure 4-9.

Table 4-76.
Public Water Supply Entities Responding to Survey with Water Supply Concerns

County	Entity	Water Supply Concern is Related to	
		Raw Water Supply	Treatment and Distribution
Bell	Prairie Haynes Youth Camp	X	
	City of Temple		X
	439 WSC		X
	Salado WSC	X	
Bosque	Lakeline Acres WC	X	
	City of Meridian	X	
Brazos	Texas A&M Main Campus		X
Burleson	Tunis WSC – D&S WS	X	
	Cade Lake WSC	X	
Comanche	City of Gustine	X	
Coryell	Multi-County WSC		X
Erath	City of Stephenville	X	
Falls	City of Lott		X
Grimes	Dobbin-Plantersville WSC 2	X	
Hamilton	City of Hico	X	X
Hill	Files Valley WSC	X	
	City of Abbot	X	
	City of Blum	X	
	City of Carl's Corner	X	
	White Bluff Community Water Supply	X	
	Hill County WSC	X	
	Bosque-Brazos Valley Water Supply	X	
	City of Whitney		X
Hood	Oak Trail Shores SW Water Supply	X	
	Arrowhead Shores SW Water Supply	X	
	Comanche Cove	X	
	Western Hills Harbor	X	
	Sky Harbor WSC – Hood Co. WC	X	
	Lipan Water Works – Hood County WC	X	
Johnson	City of Alvarado	X	
	Blue Water Oaks Subdivision	X	
	Bethany WSC	X	
	City of Burleson	X	
	Johnson County Rural Water Supply		X
	Bell Manor Subdivision	X	
	Skyline Dr. Assn. – Crest Water Corp.	X	
	City of Keene	X	
	City of Venus-Sky Corp. Water Corp.	X	
	Villa Condominiums Assn.	X	
Lee	Lee County WSC	X	
Limestone	City of Groesbeck	X	
McLennan	Cross Country WSC	X	
	Cedar Ridge Deep Well WSC		X
	Leroy-Tours-Gerald WSC	X	X
	City of West	X	
	Bold Springs WSC	X	
	City of Woodway WUD	X	
	Bosqueville Green Acres WSC		X
	Windsor Water Company	X	
	Pure WSC	X	
Milam	City of Rockdale	X	
Nolan	City of Sweetwater	X	
Palo Pinto	P-K Lodge	X	
	Rock Creek Camp	X	
	Barton WSC	X	
Robertson	Robertson County WSC	X	
	Humble Addition WSC	X	X
Shackelford	City of Albany		X
Stephens	City of Breckenridge	X	
	Stephens County WSC	X	
Washington	Deep Water Subdivision Water	X	
Williamson	Chisholm Trail SUD	X	
	Florence-Eco Resources	X	
	City of Taylor	X	X
	Jonah Water SUD	X	
	Liberty Hill WSC	X	
	Brushy Creek MUD	X	
Young	Four S Service Inc.	X	

4.5.2 Projected Manufacturing Shortages

Table 4-77 lists the counties projected to have shortages in the Manufacturing Use category, projected year 2030 and 2050 shortage, and the approximate year shortages would begin. This summary was developed from the information presented previously in Sections 4.2.1 through 4.2.37.

Table 4-77.
Counties with Projected Water Shortages for Manufacturing Use

County	Shortages Begin Prior To:	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Bell County	2000	(7,315)	(8,395)
Bosque County	2000	(704)	(903)
Coryell County	2000	(15)	(17)
Hill County	2000	(56)	(84)
Johnson County	2000	(1,309)	(1,839)
Jones County	2000	(380)	(436)
Lampasas County	2000	(108)	(128)
Limestone County	2000	(777)	(1,059)
McLennan County	2000	(4,384)	(5,617)
Nolan County	2000	(697)	(835)
Palo Pinto County	2000	(86)	(118)
Stephens County	2030	(1)	(1)
Taylor County	2000	(1,953)	(2,327)
Williamson County*	2010	0	0
Young County	2010	(223)	(299)

* Projected manufacturing demand is reported from the 1997 Consensus State Water Plan data and appears relatively low for the level of economic activity in the county. Previously, the Trans-Texas Water Plan had projected 23,700 acft/yr of manufacturing demand in the county by 2050. This additional manufacturing water demand will be planned for accordingly.

4.5.3 Projected Steam-Electric Shortages

Table 4-78 lists the counties projected to have shortages in the Steam-electric Cooling Use category, projected year 2030 and 2050 shortage, and the approximate year shortages would begin. This summary was developed from the information presented in Sections 4.2.1 through 4.2.37.

Deregulation of the electric generating industry has caused a recent increase in new "merchant" power plants being sited or planned in the region. These plants typically require 5,000 to 8,000 acft/yr of water for cooling purposes. Merchant generating plants are either planned or in construction in Bosque, Bell, and Johnson[1] Counties, and probably other locations. Projected shortages in Bosque County (and Johnson County, once projections are updated) are the result of merchant plants. Shortages in Haskell, Jones, and Young Counties result from projected expansion of existing generating facilities.

Table 4-78.
Counties with Projected Water Shortages
for Steam-Electric Use

County	Year Shortages Begin Prior to	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Bell County	2010	(11,200)	(11,200)
Bosque County	2010	(5,600)	(5,600)
Haskell County	2010	(1,709)	(1,825)
Jones County	2020	(3,824)	(3,824)
Milam County	2020	(3,498)	(6,998)
Young County	2000	(3,500)	(3,500)

4.5.4 Projected Mining Shortages

Table 4-79 lists the counties projected to have shortages in the Mining Use category, projected year 2030 and 2050 shortage, and the approximate year shortages would begin. This summary was developed from the information presented in Sections 4.2.1 through 4.2.37.

[1] The planned Johnson County plant is a recent development and its demand is not included in the demand projections. This additional demand will be planned for.

Table 4-79.
Counties with Projected Water Shortages for Mining Use

County	Year Shortages Begin Prior to	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Bosque County	2000	(136)	(235)
Johnson County	2000	(33)	(21)
McLennan County	2000	(1,071)	(1,322)
Nolan County	2000	0	0
Shackelford County	2000	(333)	(340)
Somervell County	2000	0	(6)
Williamson County	2000	(1,543)	(1,663)

4.5.5 Agricultural Water Supply and Demand

4.5.5.1 Water Resources for Agriculture

The projections for agricultural water supply and demand through 2050 were based on a 1990 database that included trends of decreasing irrigated acreage and declining profitability in agriculture.[2,3] The projections did not include impacts of future farm bills, which represent federal policy to address agricultural issues and concerns. The 1996 farm bill contained significant changes in the peanut price support program, which had a major impact on the irrigated peanut acreage in the Cross Timbers counties of Erath, Hood, Comanche, and Eastland. As a result, the irrigated acreage now is less than that of the projections. The water that is not required for irrigation now should not, however, be regarded as available for other uses. In long-range planning, an increasing profitability of agriculture should be included as a scenario. What is important to agriculture is that the land suitable for irrigated production, if brought into production, should be irrigated with existing water supplies. Future changes in economics of agricultural production, future farm bills that emphasize rural economies, and future crops could increase the profitability for irrigated crops. Energy crops, pharmaceutical crops, biomass crops, specialty or niche market crops, new fiber crops, oil-producing crops, higher transportation costs

[2] Prepared by Dr. Joe McFarland, Texas Agriculture Experiment Station, Stephenville, Texas.
[3] Texas Water Development Board (TWDB) web site, http://www.twdb.state.tx.us/wrp/reg-plan/docs/reg-plan-docs/plan-docs-index.htm

for imported food, and possibly many more economic possibilities are within the realm of the next 50 years. The water resources for future agricultural use should be preserved. An unacceptable scenario for agriculture is to advance the hypothesis that the current low profitability for agriculture will continue for the next 50 years, so the unused and available irrigation water may be transferred to municipal and industrial use. The scenario of marked declines in irrigated agriculture over the next several decades is also a scenario of significant increases in imported food at a time when the state population is also increasing dramatically. This does not bode well for regional economies of rural areas, and has implications in food security and food safety.

New, affordable water supplies cannot be developed for agricultural crop production. In virtually all of irrigated agriculture, water is managed on the demand side, not the supply side. New water supply options for agriculture include development of new wells for groundwater and acquisition of additional surface water rights. The wells will be on or very near (within a few thousand feet) to the land to be irrigated. Additional surface water rights usually come from purchase of nearby land and the attendant water rights. Historically, irrigated agriculture has expanded to make economic use of the water that is available. Conservation measures are then used to increase the economics of production and to increase the productivity. Water supply development projects in Brazos G, such as new reservoirs, have a water cost that is much too high for irrigated agriculture.

Demand side management is characterized by conservation, and virtually all irrigated agriculture producers practice water conservation in various forms. The conserved water for groundwater is available to that producer for future crop or livestock use. If the water supply is surface water, the conserved water is not withdrawn from the stream or reservoir, so it is available for other users.

Numerous text and reference books address water conservation in irrigated agriculture. Water conservation practices in widespread use in Brazos G include winter fallow for soil moisture, cultivation for weed control and soil mulch, selection and management of irrigation systems to optimize application and distribution efficiency, and scheduling irrigation to reduce deep percolation and surface runoff. Conversion of irrigation systems to increase efficiency includes converting side roll systems to center pivots with low-pressure drop nozzles and converting solid set or hand move sprinklers to drip irrigation. Demand side management has considerable potential for the future. Additional gains in water use efficiency include continued conversion of irrigation systems, improved crops and cultural practices, and improved irrigation scheduling with the use of real-time crop, soil, and weather information. These methods have costs of implementation, however.

Groundwater conservation districts are perhaps the best example of demand side management, or conservation, of water resources for agriculture.[4] Of the 45 groundwater districts in Texas, only a few (the Edwards Aquifer and the Subsidence Districts) are non-agricultural in scope. The High Plains Underground Water Conservation District No. 1 is the oldest (formed in 1951) and largest (serving all or parts of 15 counties). This district regulates well spacing and well production. Special activities include soil moisture monitoring program, pumping plant efficiency testing, tailwater abatement program, leak detection program for towns and cities, soil chemistry monitoring, low interest agricultural irrigation loan program, cost-in-water income tax depletion allowance program, and irrigation scheduling based on a potential evapotranspiration network.[5]

As of June 2000 the following groundwater conservation districts exist in the Brazos G Region:

- Clearwater Underground Water Conservation District
- Brazos Valley Groundwater Conservation District
- Lost Pines Groundwater Conservation District
- Lone Wolf Groundwater Conservation District
- Haskell/Knox Underground Water Conservation District
- Salt Fork Underground Water Conservation District

4.5.5.2 Irrigation Supply and Demand

Several aspects of irrigation water supply and demand may be different from those of municipal water supply and demand. In the areas of Brazos G northwest of IH-35, many farmers with arable land could make economic and beneficial use of increased water supplies. More land could be brought into cultivation with irrigation, or if the water had a lower cost or the crop had a greater value, more crops (such as forages) could be irrigated or could be irrigated more

[4] Texas Agricultural Extension Service (TAEX), “Managing Texas’ Groundwater Resources through Groundwater Conservation Districts,” TAEX Publication B-1612, College Station, Texas, 1998.

[5] Texas Alliance of Groundwater Districts (TAGD), “Texas Alliance of Groundwater Districts: Membership Directory and District Activities,” TAGD, Austin, Texas, 1999.

frequently. This does not constitute an unmet demand, however. To a farmer or rancher, an unmet demand is when the crop or animal is in need of water, and the water is not readily available. When a farmer plants a crop that requires irrigation, he or she would not purposefully plan for a demand that could not be met with available supply or alternative. If the water supplies are known to be short, as in low reservoir or aquifer levels, the farmer will not plant the crop. Thus, the demand will not materialize and there may even be water supply that is not used. Because drought and limited water supplies are not at all uncommon in Texas, agricultural producers, on an individual basis, plan for drought or limited water availability. Agricultural producers have three planning horizons for assessment of irrigation water supply and demand. These are the financial, the annual, and the immediate.

The financial planning horizon is for the development of irrigation capability and capacity. The cost of development of efficient irrigation systems, such as a center pivot with low-pressure drop nozzles and various forms of micro-irrigation, may approach $1000 per acre. The production value of the land, even with the irrigation system, may only be in the neighborhood of twice this value. The availability of water is the dominant factor in the decision process to develop an irrigation system. The economics of agricultural production are also very important in the financial timeframe. Irrigation operational costs (labor, electricity, maintenance, repair, and other variable costs) may be one-third to one-half or more of the total production costs. These annual costs typically are in the $25 to $75 per acft range. Except for horticultural crops or high value crops such as peanuts, the economics of agriculture preclude higher costs of water. A firm water yield must be reasonably present over the length of the financed period for a full irrigation system, which could be 20 years. Increased efficiency of irrigation equipment also requires financial planning, but over a shorter period such as a few years.

For the Seymour and Trinity Aquifers agricultural areas, in general, more land is available than water supply. Consequently, not all the producer holdings may be irrigated or the crop rotation will have to be established to match the available water supply. In the Carrizo-Wilcox Aquifer area of the Brazos Valley, sufficient groundwater is available for full irrigation of all the land area. The irrigation constraint is more the lack of suitable land for cultivation. Also, a more-or-less normal rainfall is projected throughout the period of the financing. For the horizon of the financial planning, the projected water demand will not exceed the known supply.

The annual planning horizon takes into account costs of irrigated operation, projected market values of the produce, the labor availability and costs, and other production factors. The anticipated availability of water is a major factor in this annual planning horizon. If the aquifer levels are low, if the winter carryover of stored soil moisture is low, or if the surface water supplies (e.g., lake levels) are low, the planning takes into account the decreased supply. Crops that do not require as much water may be selected, even though the projected economic return will be less. For example, grain corn and peanuts require significantly more water than silage corn or sorghum. Crops such as cotton or grain sorghum may be selected based on their ability to produce an economic return when grown under a dryland or deficit irrigation strategy. Irrigation scheduling will be more important for a producer. Measurement of water applied will be important. Producers know how to space a specified number of irrigations through the growing season for many crops such as cotton and sorghum. Other crops, especially vegetable crops, cannot produce acceptable quality if the water requirements are not met during all of the growing season. Water conservation measures such as conservation tillage may be used. The seeding rate and fertilizer rate may be decreased to increase productivity without additional water. Crop insurance is extremely important as a drought (unmet demand) strategy. The net result is that the water demand is adjusted downward to meet the projected water supply.

The third planning horizon is the immediate time frame. In Brazos G, the Texas Water Development Board (TWDB) irrigation statistics show that the average irrigation water amount applied is about 1 acft of water per acre each year.[6] The average is slightly higher in the northwest counties and slightly lower in the southeast counties. An average water use across most crops is about 2 or more acft of water each year. The difference in water availability is in the use of stored soil moisture at planting time and in rainfall during the growing season. The irrigation strategy is basically that of supplementing rainfall. If the rainfall is lacking, the irrigation demand may easily exceed the supply, especially if the system is not designed to meet the total water requirements of the crop. During dry periods, in shallow aquifer areas such as the outcrop area of the Trinity Aquifer in the Cross Timbers region, the yield of the wells decreases and salinity may be a problem. The irrigated cropland may exceed the water supply. For this short-range planning horizon, the irrigation demand will frequently exceed the supply. When the

[6] TWDB, "Surveys of Irrigation in Texas – 1958, 1964, 1969, 1974, 1979, 1984, 1989, and 1994," TWDB Report 347, Austin, Texas, 1996.

water demand increases during a drought, the water supply decreases. The strategies to adapt to the water shortage include doing nothing in short period droughts, cloud seeding, harvesting some crops early for forage, relying on crop insurance, to finally abandoning the crop.

4.5.5.3 Agricultural Attitudes toward Water

Agricultural producers with irrigation are independent water supply providers in Brazos G. In other regions, irrigation supply districts may be sources of irrigation water, but in all of Brazos G, each producer is a separate entity. Some have access to groundwater, some have surface water rights, and some have both. These independent suppliers have different attitudes and beliefs, but some generalizations may be made if for nothing more than discussion purposes.

Private property rights are fundamentally important to agricultural producers.[7] The surface water rights and the right to capture groundwater beneath their properties are viewed as rights that should not be interfered with through governmental regulation, restriction, or even oversight. This view includes central planning that involves their water rights. Local planning that protects or preserves their water rights should be an acceptable course of action, but lines may be drawn. These include access to private property, reporting of water pumped, and restrictions on the ultimate use of water (which could include water marketing). These restrictions include permitting of wells, definitions and enforcement of "waste" of the water, limitations on the amount of water that may be used, and perhaps many more examples.

The preference for voluntary actions in agriculture to address water quantity and quality issues is strongly held in agriculture. Voluntary actions do not threaten private property rights and avoid the problems inherent with regulatory programs. When the benefits of the voluntary actions do not result in significant personal economic returns to the agricultural producer, the adoption of practices to conserve water or protect water quality will be modest at best, and will be ineffective at worst. Programs for agriculture to conserve water quantity or protect water quality for the benefit of downstream users should have very strong and effective education, technical assistance, and financial assistance components.[8]

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[7] Smith, George F., "Water Quality and Quantity Issues for the South – Preparing for the Challenges of the 21st Century," No. 7, Southern Rural Development Center, Mississippi State, Mississippi, 2000.
[8] Tuck, Comer, "Agricultural Water Conservation Programs in Texas. In: The new water agenda," Proceedings of Conserv93, Dec 12-16, 1993, Las Vegas, Nevada, American Water Works Association (AWWA), Denver, Colorado, 1587-1592, 1993.

Regionally, agriculture views the water as "their water." Agriculture interests, in general, believe that water should not be an exportable commodity, but should remain as a resource for current or future regional use. This is the sustainability concern that is national in scope. The next generation should have the same or better opportunity as the current generation. This applies not only to water quantity, but also to water quality, soil, exotic plants and pests, and regional infrastructure. Agriculture will not take a favorable view of export of water from one region to another, because the loss of the water also represents a loss of future development capability. The Owens Valley of California is a classic example of an area that will never develop economically because the land is owned, the groundwater is developed, and the water is exported by the City of Los Angeles, 250 miles to the west.

Agricultural interests have had to rely on water conservation and management strategies to keep water demands in line with water supplies. The development of new sources of water, with two exceptions, has not been an option in a state without a federal subsidy of surface water development. The two exceptions of water resource development are cloud seeding and brush control. These are effective, but a firm yield cannot be assigned. Agricultural interests fully expect those entities representing water planning for municipal and industrial use to make full use of water conservation and management strategies, as opposed to the reallocation of agricultural water supplies to meet future needs. A strategy of market forces to reallocate the water supplies of the state for future needs will not be supported by agriculture in general and rural areas in specific. Transfers of water from irrigation to urban and industrial use will occur as urban and suburban areas expand into agricultural areas. The loss of farmland to urban areas is a separate but related national issue.

Agricultural interests are joined by environmental and recreational interests in the belief that water should be allocated and/or protected for lower value uses. This coalition will not support any strategy that relies on market value of water to meet growth corridor needs. The value of water as a utility in urban use is greater by a factor of about ten than the value of water for agricultural production. A 1994 water policy report[9] stated that many are questioning whether the state's overriding principle for water planning should be to ensure a sufficient supply to meet projected growth or whether greater reliance should be placed on improved water

[9] Lyndon B. Johnson School of Public Affairs, "Squeezing a Dry Sponge: Water Planning in Texas," Policy Research Project on Water for the Environment, Policy Research Project Report Number 111, Austin, Texas, 1994.

management techniques to control the need for new supplies. Growth management based on consensus regional planning is generally advocated by agricultural and environmental interests.

Texas A&M University conducted a survey of regional planning officials in the 16 Regional Water Planning Groups.[10] The questionnaire was returned by 205 of the officials, which represented a 65 percent return. The attitudes, expressed as a preference-feasibility analysis, ranked 20 strategies for water conservation. Agricultural water conservation strategies in the survey were: require planting drought-resistant crops, require agricultural irrigation schedule, require lining of water conveyance canals, require efficient agricultural irrigation equipment, and brush control. A ranking by the sum of the preferences and the feasibility on 1 to 5 scale (5 being high) showed efficient irrigation equipment to be the fourth-highest overall. Brush management was tenth, and the other strategies were fourteenth and a tie for sixteenth.

A related survey is interesting from the standpoint of agricultural producer attitudes toward water conservation and assistance programs.[11] In 1985, Texas voters approved the sale of bonds to finance low interest agricultural loans to finance water efficient irrigation equipment. The legislation authorized the TWDB to lend funds to the soil and water conservation districts to finance the purchase of approved water conservation equipment. A $5 million pilot program produced only a limited response, according to a Texas A&M University and Texas Tech University study in 1994. The response from 254 producers in the Texas High Plains, the Winter Garden, and the Lower Rio Grande Valley showed a 94 percent belief that water conserving irrigation equipment is an approach to increasing efficiency of water use in agriculture. However, 63 percent opposed any government intervention through legislative actions. Only 57 percent believed that the benefits exceeded the costs of implementation. The factors that were identified in the study were interest rates, amount of paperwork, income level, and amount of short-term debt.

One general, albeit arguable, conclusion about agricultural attitudes toward water is that farmers and ranchers are strong advocates of demand side management of water resources. The supply side management options of groundwater and surface water development have been

[10] Kaiser, Ronald A., Bruce J. Lesikar, C. Scott Shafer, and Jan R. Gersten, "Water Management Strategies: Ranking the Options," The Texas A&M University System, College Station, Texas, 2000.
[11] Stanaland, B. S. Misra, E. Segarra, and R. Lacewell, "Producer Response to A Subsidized Agricultural Water Conservation Program," Unpublished Manuscript, Department of Agricultural Economics, Texas A&M University and Department of Agricultural Sciences, Texas Tech University, College Station and Lubbock, Texas, September 1994.

developed. Without the presence of a federal agency, such as the Bureau of Reclamation, to develop a subsidized water supply from new reservoirs, there will be no new water supplies for agriculture. Agricultural interests expect other users to manage water supplies on the demand side also.

The history of water planning in Texas parallels the water planning in agriculture. Prior to the 1970s, the emphasis was on water supply management.[12] It was viewed as the responsibility of the State to develop sufficient water supplies to meet the needs of an increasing population and industrial base. New reservoirs were constructed and water treatment and delivery systems were developed. During the 1970s, the emphasis on water supply management began to change to water demand management, with conservation as a major focus. The statewide average per capita municipal water use is decreasing, and the TWDB projections through 2050 reflect this trend. The trend can be attributed to more efficient plumbing fixtures and appliances, demographic and housing changes, increasing water and wastewater costs, and the advent of organized water conservation educational programs. Water-use rates in industry have also been declining as a result of new technologies, market forces, regulatory considerations, and reuse of water.

The Texas Water Plan of 1984 marked the first time that water conservation was explicitly factored into the long-range water plans.[13] This may have been triggered by the failure of Proposition Four in 1981, which could have provided funding for massive intrastate and interstate water transfer plans. The passage of House Bill 2 in 1985 greatly expanded the statutory meaning of water conservation and laid the groundwork for much of the current water conservation policies and programs in the municipal, industrial, and agricultural sectors. The State Water Plans of 1990,[14] 1992, and 1997[15] reflect a balanced approach of supply and demand side water planning. Agricultural interests strongly support demand side water planning, as opposed to planning strategies that focus on supply side transfers of water from irrigated agriculture to municipal and industrial use.

[12] Personett, Mike, "The Evolutions of State Water Conservation Policy in Texas," In: The New Water Agenda, Proceedings of Conserv93, Dec 12-16, 1993, Las Vegas, Nevada, AWWA, Denver, Colorado. 957-965.
[13] Ibid.
[14] TWDB, "Water for Texas: Today and Tomorrow," TWDB Report GP-5-1, Austin, Texas, 1990.
[15] TWDB, "Water for Texas," TWDB Report GP-6-2, Austin, Texas, 1997.

4.5.5.4 Livestock

Livestock water may be managed on the supply side through the construction of non-permitted surface water impoundments of less than 200 acft capacity. These stock tanks, typically with a capacity of only a few acft, are constructed in any available ephemeral stream channel to impound water for livestock on pasture or range. Confined livestock water supply is in the same economic category as irrigated agriculture. Confined livestock operations, such as the poultry industry in the Brazos Valley and the dairy industry in the Cross Timbers, is reliant on groundwater. The water resource is managed on the demand side.

4.5.5.5 Summary of Agricultural Supply and Demand

Agricultural water is planned and managed on the demand side to keep the variable demand in approximate balance with the projected supply. When the supply is known to be decreased, the demand is reduced through conservation and other management actions. The economics of development of new water supplies preclude the development of new water supplies for agriculture. Construction of stock tanks for livestock water is a minor, but important exception.

4.5.5.6 Projected Irrigation Shortages

Table 4-80 lists the counties projected to have shortages in the Irrigation Use category, projected year 2030 and 2050 shortage, and the approximate year shortages would begin. This summary was developed from the information presented in Sections 4.2.1 through 4.2.37. Figure 4-10 contains a map indicating counties with projected shortages.

Table 4-80.
Counties with Projected Water Shortages for Irrigation Use

County	Approximate Year Shortages Begin	Projected Shortages (acft/yr)	
		Year 2030	Year 2050
Comanche County	2000	(13,475)	(12,477)
Eastland County	2000	(7,423)	(7,443)
Knox County	2000	(2,199)	(779)
Shackelford County	2000	(179)	(167)
Stephens County	2000	(341)	(328)
Taylor County	2000	(68)	(47)
Young County	2000	(265)	(235)

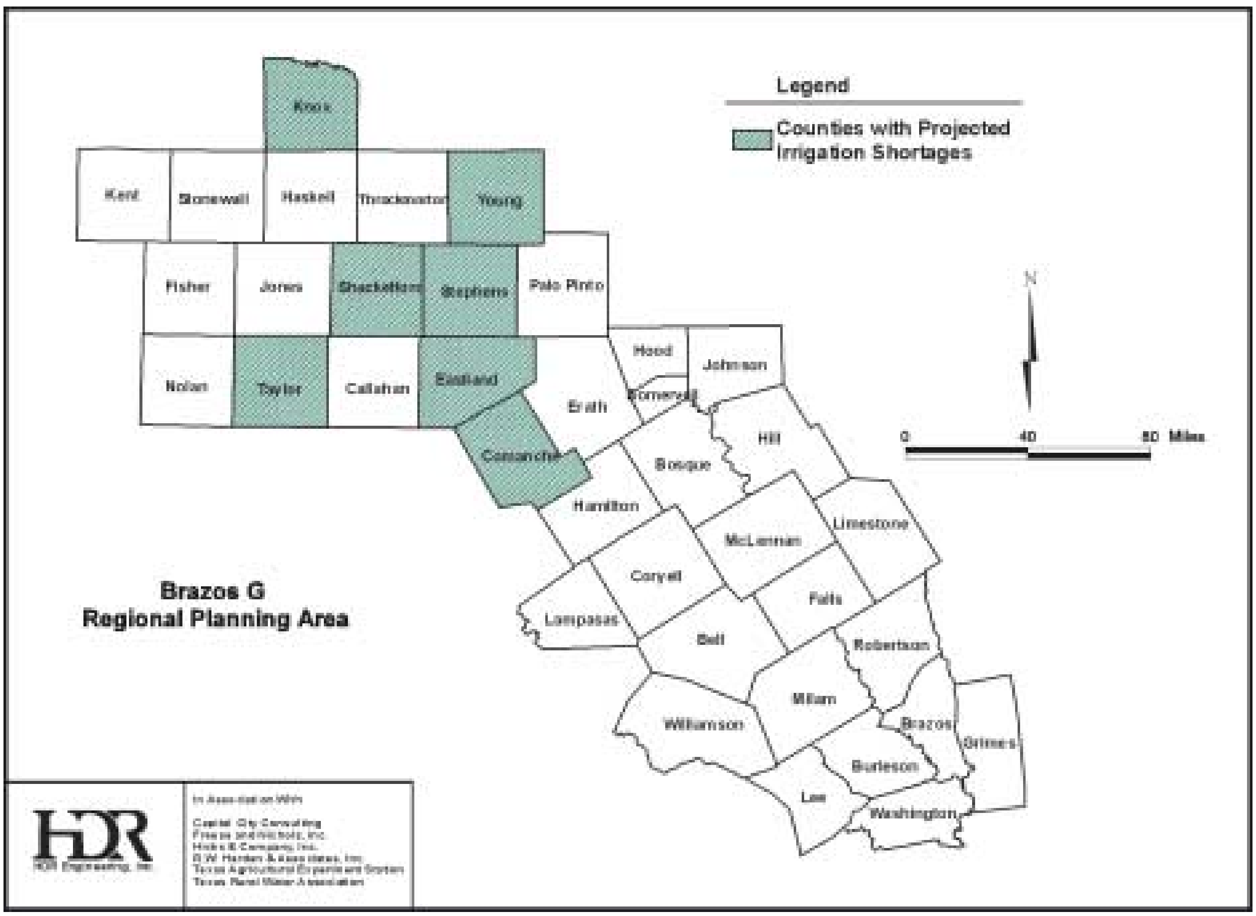

Figure 4-10. Projected Irrigation Water Shortages

Projected irrigation demand (and resulting projected shortages) necessarily contain a number of assumptions and are based on trends in existence at the time the projections were published in 1996. In most of the counties in Brazos G, the actual changes between 1990 and 1999 have been greater than the projected changes from 1990 to 2050. For Comanche and Eastland Counties, the 1996 Farm Bill changed the peanut price support and quota system, with the result that irrigated acreage and water use of peanuts decreased markedly from 1997 to the present. Changes in farm policy, as contained in the Farm Bills, were not included in the projections. Based on actual irrigated acres and estimated irrigation water volumes in 1999, the projected irrigation demand in 2050 is lower than the projected irrigation supply. If there are no changes in farm policy or farm economics, there will not be irrigation water shortages in Comanche or Eastland Counties. However, if the farm economies and/or farm policy change, the groundwater in the Trinity Aquifer and surface water from the Leon River System (Lake Leon, Lake Proctor, and the Leon River) will be a valuable resource for renewed agricultural production. Irrigation shortages could easily exist for all areas of the Trinity Aquifer area that underlay productive soils.

Knox County projections for irrigation shortages similarly reflect the base year of 1990 and the assumptions inherent with the projections. However, the shortages actually decrease with time from 6,346 acft in 2000 to 2,660 acft in 2050. This indicates that much of the irrigation in Knox County and the rest of the Seymour Aquifer area in Brazos G is deficit irrigation; that is, the amount of irrigation water applied to the crop is not sufficient to meet the full water requirements of the crop. This is especially true in a year with limited rainfall prior to and during the growing season. The projection scenario indicates that irrigated acreage will decrease, but that the amount of irrigation water will remain the same. As with the counties in the Trinity Aquifer area, any change in farm policy or farm economics that makes row crop agriculture more productive will increase the irrigation demands. The projected shortages could easily be at or above the year 2000 levels.

For the other counties in Table 4-80, the irrigated acreage is relatively low and the irrigation water available is also low. These shortages should not have a significant impact on irrigated agriculture or water availability.

4.5.6 Projected Livestock Shortages

There are no livestock shortages. As explained in Section 4.1, surface water from stock ponds and streams was shown to be available to meet livestock needs when groundwater supplies were insufficient to meet those demands.

4.6 Comparison of Demand to Supply with Water Quality Considerations

Characterizing water supplies and demands relative to water quality provides an important component of the regional plan. By addressing supply water quality over and against a common standard, the plan can identify where water is "available" but not necessarily "usable." In the context of comparing water supply options to meet a demand, it is important to know the quality of the alternate supplies in order to know the costs associated to treat it so that it meets the needs of the user(s). This section provides information for surface water that shows the amount available, the amount considered surplus (exceeds the demand), and the amount that is available but does not meet common standards (i.e., the Texas secondary drinking water standards for total dissolved solids (TDS) and chlorides). Also presented in this section, is a tabular description of water quality in the Brazos River in terms of TDS and chloride content of the water (Table 4-81).[1] The data from which the averages in Table 4-82 are derived are flow-weighted and relatively long-term so that wet and dry periods are mitigated.

Table 4-81.
General Water Quality Characterization of the Brazos River

Monitoring Station	Average Flow-Weighted Concentrations		Years of Record
	TDS (mg/L)	Cl^- (mg/L)	
Brazos River at Seymour	3,660	1,448	1960 to 1986
Brazos River at South Bend	1,385	546	1942 to 1948 1978 to 1981
Brazos River at Possum Kingdom Dam	1,482	574	1942 to 1986
Brazos River near Dennis	1,450	569	1971 to 1986
Brazos River near Whitney	915	330	1949 to 1986
Brazos River near College Station	477	126	1962 to 1983
Brazos River at Richmond	386	95	1946 to 1986
Texas Secondary Drinking Water Standards	1,000	300	

[1] Ganze, C. Keith and Ralph A. Wurbs, "Compilation and Analysis of Monthly Salt Loads and Concentrations in the Brazos River Basin," U.S. Army Corps of Engineers Contract No. DACW63-88-M-0793, January 1989.

Table 4-82 summarizes municipal surface water available for each county. Total surface water available for each county (Column 3) is the amount, either through water rights or contracts, that is available to meet the demand in the county. The surface water available that meets standards (Column 2) is that amount available from sources whose TDS and chloride concentrations are generally less than 1,000 mg/L and 300 mg/L, respectively. In several counties, portions of the total available surface water do not meet secondary drinking water standards. In these counties it is important to assess the impact of water quality on the supplies and demands. This is depicted graphically in Figure 4-11.

Table 4-82.
Municipal Surface Water Availability
Meeting Texas Secondary Constituent Levels[1]

County	Surface Water Amount Meeting Standards[1] (acft/yr)	Total Surface Water Available (acft/yr)	Percentage of Municipal Surface Water Meeting Standards[1]
Bell	95,076	95,076	100%
Bosque	1,673	1,693	99%
Brazos	8,009	8,009	100%
Burleson	0	0	N/A
Callahan	2,234	2,234	100%
Comanche	1,139	1,139	100%
Coryell	23,098	23,098	100%
Eastland	5,100	5,550	92%
Erath	3,254	3,254	100%
Falls	6,364	7,664	83%
Fisher	603	603	100%
Grimes	0	0	N/A
Hamilton	1,430	1,430	100%
Haskell	2,388	2,561	93%
Hill	6,344	7,154	89%
Hood	0	25,050	0%
Johnson	12,866	26,335	49%
Jones	2,731	4,494	61%
Kent	0	0	N/A
Knox	653	653	100%
Lampasas	7,417	7,417	100%
Lee	0	0	N/A
Limestone	435	4,727	9%
McLennan	87,506	100,001	88%
Milam	3,332	3,332	100%
Nolan	5,093	5,093	100%
Palo Pinto	12,120	14,471	84%
Robertson	0	0	N/A
Shackelford	1,988	1,993	100%
Somervell	0	0	N/A
Stephens	22,185	22,185	100%
Stonewall	93	93	100%
Taylor	53,175	53,175	100%
Throckmorton	255	255	100%
Washington	4,619	4,619	100%
Williamson	76,803	76,803	100%
Young	8,384	9,384	89%

[1] Texas Secondary Constituent Levels; chloride concentration = 300 mg/L; Total Dissolved Solids concentration = 1,000 mg/L.

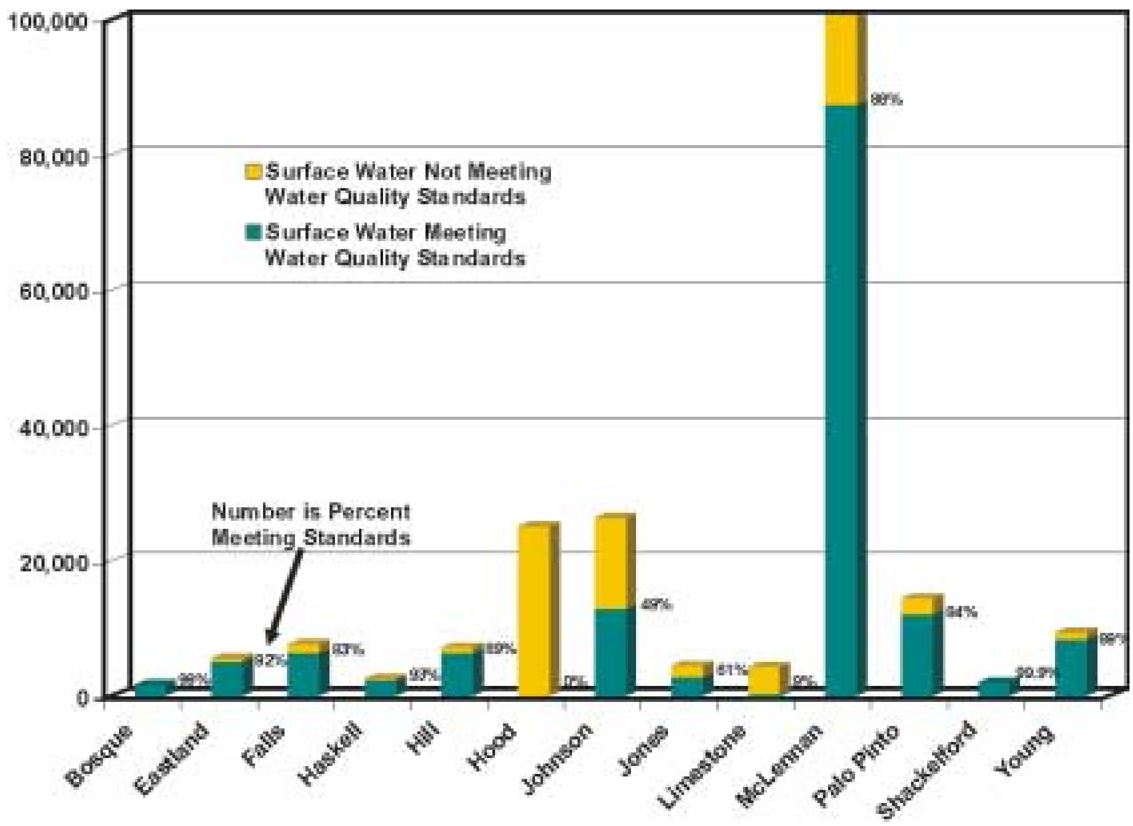

Figure 4-11. Surface Water Quality Meeting Secondary Drinking Water Standards

4.7 Region Summary

The following observations are made regarding current and future water needs of the Brazos G region:

1. Water needs in the next 50 years are created, for the most part, by population growth, groundwater depletion, declining reservoir yields, and natural salt pollution of surface water.
2. High growth along I-35, particularly in Williamson and Johnson Counties, is creating water needs. Bell, McLennan, and Hill Counties, as well as counties just west of I-35, overlay the Trinity Aquifer and are experiencing rapid growth – thereby straining modest groundwater supplies.
3. Groundwater will continue to be a major water supply in much of the region and available supply has been allocated to meet demands – implicit in this is a management strategy to fully develop groundwater sources.
4. The Carrizo-Wilcox Aquifer east of I-35 provides adequate long-term supply to the overlying counties; in many cases, new facilities are needed to use this supply.
5. Slower economic growth, and implementation of previous long-term planning, results in fewer long-term municipal needs in the upper Brazos G Region.
6. Many of the needs can be met with contractual changes, but may require new delivery facilities to move available supplies.
7. Water availability in a county does not mean that all local water utilities have adequate water - infrastructure and contract limitations create needs in some areas.
8. The biggest challenge to many communities is financing construction of delivery and treatment facilities, rather than securing new water sources.
9. Deregulation of electric generation is prompting construction of merchant power plants and water supplies must be found to meet these prospective significant water demands.
10. Agriculture irrigation demands are heavily influenced by government farm policy and long-term projections of agricultural water use have uncertain accuracy.
11. With farm economics and policy changes, Trinity Aquifer groundwater and Leon River surface water could become a limiting resource for renewed agricultural production.
12. Irrigation shortages are typical during dry years for areas using deficit irrigation practices, and little, if any, water management changes are indicated.
13. Demand/supply comparisons show where water is available, but water quality (TDS and chlorides) influences whether water is usable or economically treatable. Counties where this is of concern include Jones, Johnson, McLennan, Palo Pinto, Haskell, Hood, Young, and possibly others.

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4.8 Socio-Economic Impacts of Not Meeting Water Needs

Section 357.7(4) of the rules for implementing Senate Bill 1 require that the social and economic impact of not meeting regional water supply needs be evaluated by the Regional Water Planning Groups. The Texas Water Development Board is required to provide technical assistance, upon request, to complete the evaluations. The Brazos G Regional Water Planning Group submitted a request to TWDB for assistance. TWDB evaluated each unmet water need, using data that connected water use with the economy and the population of the region.[1] The purpose of this element of Senate Bill 1 planning is to give the regions an estimate of the potential costs of not acting to meet anticipated needs in each water user group, or conversely, the potential benefit to be gained from devising a strategy to meet a particular need. Collectively, the summation of all the impacts gives the region a view of the ultimate magnitude of the impacts caused by not meeting all of the entire list of needs. These summations should be considered a worst-case scenario for the region, since the likelihood of not meeting the entire list of needs is very small.

Each water user group with a need was evaluated in terms of direct and indirect economic and social impact on the region resulting from the shortage. Economic variables chosen by TWDB for this analysis include gross economic output (sales and business gross income), employment (number of jobs) and personal income (wages, salaries and proprietors net receipts). The effects of shortages on population and school enrollments are the social variables of the analysis. Declining populations indicate a deprecation of social services in most, but not every case, while declining school enrollment indicates loss of younger cohorts of the population and possibilities of strains on the tax bases, when combined with economic losses.

Summary of Results

Table 4-83 summarizes the relationship of projected water shortages to employment, population, and income in the region for the 2000 to 2050 time period. Total water demand in the region is projected to increase from 726,080 acft in 2000 to 948,190 acft in 2030, and continuing to increase to 1,034,599 acft in 2050. Under extreme supply limitations and with no management strategies in place, water shortages would amount to 57,859 acft in 2000, rising to 151,735 acft in 2030 and to 209,639 acft by 2050.

As shown in Table 4-83, unmet water needs of the region amount to about 13.5 percent of the forecasted demand by 2020, rising to 17.5 percent of demand in 2040 and 20.3 percent in 2050. This means that by 2050 the region would be able to supply only 80 percent of projected needs unless supply development or other water management strategies are implemented.

Economic Growth Limitations

The difference between expected future growth, unrestricted by water shortage, and expected growth restricted by unmet water needs provides the measure of impact.

Employment

Left entirely unmet, projected shortages in 2010 result in 93,000 fewer jobs than would be expected in unrestricted development (without water needs) by 2010. The gap between unrestricted and restricted job growth grows to 253,000 by 2030,and to 440,000 jobs that the restricted economy could not create by 2050.

Population

The forecasted population growth of the region would be economically restricted by curtailed potential job creation. This in turn causes both an outmigration of some current population and an expected curtailment of future population growth. Compared to the baseline growth in population, the region could expect 199,000 fewer people in 2010, growing to 545,000 fewer in 2030 and 947,000 fewer in 2050. The expected 2050 population under the severe shortage conditions would be 31 percent lower than projected in the region's most likely growth forecast.

Income

The potential loss of economic development in the region amounts to about 13 percent less income to people in 2010, with the gap growing to 27 percent less than expected in 2030. By 2050 the region would have 38 percent less income than is currently projected assuming no water restrictions.

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[1] A printout of the socio-economic impact estimates of projected unmet water demands is available on request from the Brazos River Authority or HDR Engineering.

Table 4-83.
Estimated Effects of Water Shortages on Employment, Population, and Income

Water			
Decade	**Projected Demand (acft)**	**Projected Water Shortage (acft)**	**Percent Shortage**
2000	726,080	(57,859)	8.0%
2010	832,642	(85,978)	10.3%
2020	904,736	(122,022)	13.5%
2030	948,190	(151,735)	16.0%
2040	990,383	(172,908)	17.5%
2050	1,034,599	(209,639)	20.3%

Employment			
Decade	**Baseline Employment (FTE Jobs)**	**Employment with Water Shortage (FTE Jobs)**	**Percent Loss**
2000	639,962	576,014	10.0%
2010	745,744	652,216	12.5%
2020	841,678	668,075	20.6%
2030	941,341	688,255	26.9%
2040	1,040,899	696,830	33.1%
2050	1,140,250	700,145	38.6%

Population			
Decade	**Baseline Population**	**Population with Water Shortage**	**Percent Loss**
2000	1,672,819	1,537,582	8.1%
2010	2,007,668	1,808,936	9.9%
2020	2,362,341	1,989,902	15.8%
2030	2,639,033	2,094,253	20.6%
2040	2,882,090	2,143,086	25.6%
2050	3,096,910	2,150,092	30.6%

Income			
Decade	**Baseline Income (millions, 1999 $)**	**Income with Water Shortage (millions, 1999 $)**	**Percent Loss**
2000	18,109	16,208	10.5%
2010	21,102	18,330	13.1%
2020	23,817	18,811	21.0%
2030	26,637	19,441	27.0%
2040	29,454	19,757	32.9%
2050	32,266	19,902	38.3%

Source: Texas Water Development Board, "Socio-Economic Impacts of Not Meeting Water Needs, Brazos G Regional Water Planning Group (Region G)," August 9, 2000.

Water User Groups with Shortages

The economic and social impact of an unmet water need varies greatly depending on the type of water user group for which the shortage is anticipated. On a per acre-foot basis, the largest impacts will generally result from shortages in manufacturing and municipal uses, while shortages for irrigation will typically result in the smallest impact. Table 4-85 presents the impacts of unmet water needs summarized for each of the six types of water user groups. Table 4-84 summarizes projected impacts of unmet demands before management strategies are in place. Table 4-84 should be used only for measuring the extreme limit of lost potential economic development for the region as a whole, caused by lack of development of new water supplies in the region for those water user groups in need of supply. The data are not a prediction or forecast of water shortages, but show the cumulative effect of simultaneous unmet needs for those with potential shortages.

Water shortages in the Brazos G region are relatively evenly distributed among water user groups until the year 2020, when unmet municipal water needs begin to grow rapidly. In 2010, municipalities have unmet needs of 24,138 acft, or 28 percent of the total unmet needs. The economic impacts of this shortage (34,068 jobs, $2.3 billion in output, and $885 million of income) represent approximately 25 to 35 percent of the total impacts. By 2050, unmet municipal needs total 131,021 acft (63 percent of the total) resulting in 329,893 jobs not created, and $8.9 billion in potential income (more than 70 percent of the total impact).

The impact of not meeting manufacturing needs grows over time. In 2010, manufacturing has unmet needs of 10,489 acft, or 12 percent of the total unmet needs. The economic impacts of this shortage include loss of 56,537 jobs (60 percent of the total employment impact) and $6 billion in output (69 percent of the total output impact). In 2050, unmet manufacturing needs are 19,777 acft (9 percent of the total) resulting in 106,149 jobs not created and reduction of $11.4 billion in output (36 percent of the total output impact).

Unmet irrigation needs represent a significant amount of need, but, due to the relatively small value of economic output added per acre-foot, the impacts of not meeting irrigation needs are considerably less. In 2010, irrigation has unmet needs of 26,711 acft, or 21 percent of the total. However, the economic impacts of the shortage represent less than 1 percent of the total economic impact. Unmet irrigation needs decline over the time period of the analysis.

Table 4-84.
Summary of Socio-Economic Impacts of Not Meeting Needs

Category	Decade	Value of Need (acft)	Impact of Need on Employment	Impact of Need on Gross Business Output in 199 U.S. Dollars (millions)	Impact of Need on Population	Impact of Need on School Enrollment	Impact of Need on Income in 1999 U.S. Dollars (millions)	Number of WUGs with Needs
Municipal	2000	(57,859)	63,948	6,372.8	135,237	34,030	1,900.9	72
Manufacturing	2000	(57,859)	63,948	6,372.8	135,237	34,030	1,900.9	72
Steam-Elec.	2000	(57,859)	63,948	6,372.8	135,237	34,030	1,900.9	72
Mining	2000	(57,859)	63,948	6,372.8	135,237	34,030	1,900.9	72
Irrigation	2000	(57,859)	63,948	6,372.8	135,237	34,030	1,900.9	72
Livestock	2000	(57,859)	63,948	6,372.8	135,237	34,030	1,900.9	72
Total		(347,154)	383,688	38,236.8	811,422	204,180	11,405.3	
Municipal	2010	(85,978)	93,528	8,806.7	198,732	50,144	1,772,0	86
Manufacturing	2010	(85,978)	93,528	8,806.7	198,732	50,144	1,772,0	86
Steam-Elec.	2010	(85,978)	93,528	8,806.7	198,732	50,144	1,772,0	86
Mining	2010	(85,978)	93,528	8,806.7	198,732	50,144	1,772,0	86
Irrigation	2010	(85,978)	93,528	8,806.7	198,732	50,144	1,772,0	86
Livestock	2010	(85,978)	93,528	8,806.7	198,732	50,144	1,772,0	86
Total		(515,868)	561,167	52,840.3	1,192,392	300,864	16,632.3	
Municipal	2020	(122,022)	173,604	14,422.5	372,439	94,369	5,005.9	94
Manufacturing	2020	(122,022)	173,604	14,422.5	372,439	94,369	5,005.9	94
Steam-Elec.	2020	(122,022)	173,604	14,422.5	372,439	94,369	5,005.9	94
Mining	2020	(122,022)	173,604	14,422.5	372,439	94,369	5,005.9	94
Irrigation	2020	(122,022)	173,604	14,422.5	372,439	94,369	5,005.9	94
Livestock	2020	(122,022)	173,604	14,422.5	372,439	94,369	5,005.9	94
Total		(732,132)	1,041,622	86,535.3	2,234,634	566,214	30,035.7	
Municipal	2030	(151,735)	253,085	19,864.5	544,780	139,332	7,195.9	99
Manufacturing	2030	(151,735)	253,085	19,864.5	544,780	139,332	7,195.9	99
Steam-Elec.	2030	(151,735)	253,085	19,864.5	544,780	139,332	7,195.9	99
Mining	2030	(151,735)	253,085	19,864.5	544,780	139,332	7,195.9	99
Irrigation	2030	(151,735)	253,085	19,864.5	544,780	139,332	7,195.9	99
Livestock	2030	(151,735)	253,085	19,864.5	544,780	139,332	7,195.9	99
Total		(910,410)	1,518,512	119,187.3	3,268,680	835,992	43,175.2	
Municipal	2040	(172,908)	344,070	25,544.4	739,004	189,034	9,697.0	100
Manufacturing	2040	(172,908)	344,070	25,544.4	739,004	189,034	9,697.0	100
Steam-Elec.	2040	(172,908)	344,070	25,544.4	739,004	189,034	9,697.0	100
Mining	2040	(172,908)	344,070	25,544.4	739,004	189,034	9,697.0	100
Irrigation	2040	(172,908)	344,070	25,544.4	739,004	189,034	9,697.0	100
Livestock	2040	(172,908)	344,070	25,544.4	739,004	189,034	9,697.0	100
Total		(1,037,448)	2,064,417	153,266.4	4,434,024	1,134,204	58,182.0	
Municipal	2050	(209,639)	440,105	31,726.8	946,818	242,668	12,363.4	108
Manufacturing	2050	(209,639)	440,105	31,726.8	946,818	242,668	12,363.4	108
Steam-Elec.	2050	(209,639)	440,105	31,726.8	946,818	242,668	12,363.4	108
Mining	2050	(209,639)	440,105	31,726.8	946,818	242,668	12,363.4	108
Irrigation	2050	(209,639)	440,105	31,726.8	946,818	242,668	12,363.4	108
Livestock	2050	(209,639)	440,105	31,726.8	946,818	242,668	12,363.4	108
Total		(1,257,834)	2,640,631	190,361.1	5,680,908	1,456,008	74,180.3	

Source: Texas Water Development Board, "Socio-Economic Impacts of Not Meeting Water Needs, Brazos G Regional Water Planning Group (Region G)," August 9, 2000.

The region also forecasts unmet needs in steam electric power (with employment impact of less than 3,000 jobs) and in livestock and mining (with employment impact of less than 500 jobs).

Interpretation of the Results

Readers are cautioned that potential estimated social and economic impacts is not a prediction of future water disasters. These estimated impacts simply give regional planners one source of information by which to develop efficient and effective means to meet projected water needs and avoid calamities.

Some clarification is needed to understand the estimated impacts. The following points must be kept in mind when using the results:

a. Water supplies are calculated on drought-of-record levels. Shortages that show up for the 2000 decade and beyond are considered to be mostly the result of severe dry conditions; this contributes to the apparent abnormally large size of some impacts. This approach to supply analysis results in a worst-case scenario. Historically, most water user groups have at least partially met their needs through management of the remaining supplies, either by conservation, limitations on lower-valued uses such as lawn watering, or finding alternative sources of water. The results in this report assume no applied management strategies and the entirety of the needs is not met in any fashion.
b. The Municipal water use category includes commercial establishments. The impacts from even small shortages in many such establishments are considerably higher on a per-acre-foot basis than in any other category. Thus, relatively small Municipal shortages can have a very large amount of economic impact, since the analysis assumes a direct relationship between curtailed water use and lost economic production. Since this analysis is intended to provide impacts without assuming any strategies, the normal response of conservation programs is not assumed. The impact data appear to overstate the Municipal category, but the results are consistently measured, since no response to the shortage is assumed that would mitigate loss of critical water used in commercial and residential settings.
c. The sizes of the projected impacts do not represent reductions from the current levels of economic activity or population. That is, the data are a comparison between a baseline forecast, assuming no water shortages, and a restricted forecast, based on the assumption of future water shortages. In some cases, with severe water shortages the regional economy could actually decline, dropping employment below current levels. For most regions, however, the measurement of impact represents an opportunity cost, or lost potential development that would be foregone in the absence of water management strategies.

Section 5A
Identification, Evaluation, and Selection of Water Management Strategies

5A.1 Water Management Strategies

Title 31 TAC 357.7(a)(6) requires that the regional water planning group evaluate all water management strategies determined to be potentially feasible, including 15 named strategies.[1] At the beginning of the planning effort, the Brazos G Regional Water Planning Group (RWPG) determined 19 water management strategies to be potentially feasible. The Brazos G RWPG also determined that two strategies were not feasible. Those two strategies are dredging of reservoirs to enhance yield and cancellation of water rights. Potential water supply strategies examined during the course of this study are listed in Table 5A.1-1. This section describes methods and procedures utilized to evaluate water management strategies considered for inclusion in the water plan for the Brazos G region.

Within some of the 19 types of water management strategies listed in Table 5A.1-1 there are a number of sub-options. For instance, in the section on New Reservoirs (Section 5A.14), six potential reservoir sites are evaluated. Likewise, other sections, including Expanded Use of Existing Supplies (5A.4), Enhancement of Reservoir Yields (5A.7), Control of Naturally Occurring Chlorides (5A.8), Desalination (5A.11), Off-Channel Reservoirs (5A.15), Regional Surface Water Systems (5A.16), Carrizo-Wilcox Aquifer Development (5A.17), and Interconnection of Regional and Community Systems (5A.20) each contain a number of options within that type of management strategy.

5A.1.1 Evaluation of Strategies

The following chapters contain an evaluation of each of the potential water management strategies. Each section is typically divided into five subsections: (1) Description of Option; (2) Yield Available; (3) Environmental Issues; (4) Engineering and Costing; and (5) Implementation Issues. Information in these sections was presented to the RWPG and was used in evaluating strategies to meet water needs in the region.

[1] Title 31 TAC 357.7(a)(6) lists 15 potential strategies: conservation; wastewater reuse; expanded use of existing supplies; reallocation of reservoir storage; voluntary redistribution; enhancement of existing sources; chloride control; interbasin transfers; new supplies; strategies from past State water plans; brush control; weather modification; desalination; cancellation of water rights; and aquifer storage and recovery

Table 5A.1-1.
Water Management Strategies Evaluated for the Brazos G Region

Section No. (Located in Volume 2)	Title
5A.1.5 (Vol. I)	Agricultural Water Management Strategies
5A.2 (Vol. II)	Water Conservation
5A.3 (Vol. II)	Wastewater Reuse
5A.4 (Vol. II)	Expanded Use of Existing Supplies
5A.5 (Vol. II)	Reallocation of Reservoir Storage
5A.6 (Vol. II)	Voluntary Redistribution
5A.7 (Vol. II)	Enhancement of Reservoir Yields
5A.8 (Vol. II)	Control of Naturally Occurring Chlorides
5A.9 (Vol. II)	Brush Control and Range Management
5A.10 (Vol. II)	Weather Modification
5A.11 (Vol. II)	Desalination
5A.12 (Vol. II)	Aquifer Storage and Recovery
5A.13 (Vol. II)	Cancellation of Water Rights
5A.14 (Vol. II)	New Reservoirs
5A.15 (Vol. II)	Off-Channel Reservoirs
5A.16 (Vol. II)	Regional Surface Water Systems to Augment Declining Groundwater Supplies
5A.17 (Vol. II)	Carrizo-Wilcox Aquifer Development
5A.18 (Vol. II)	Water Trades in the Brazos River Basin
5A.19 (Vol. II)	Conjunctive Use in the Brazos River Alluvium
5A.20 (Vol. II)	Interconnection of Regional and Community Water Systems

5A.1.2 Plan Development Criteria

It is the goal of the RWPG to develop a plan to meet projected water needs within the region. The RWPG has adopted a set of Plan Development Criteria that was used to evaluate whether a given strategy should be used to meet a projected shortage and ultimately be included in the Brazos G Water Supply Plan. The proposed plans were developed by evaluating the water management strategies using the RWPG criteria and then matching strategies to meet projected shortages. This section discusses the evaluation criteria adopted by the planning group during plan development, and criteria to be met in formulation of the plan. The adopted plan elements will meet these criteria:

- Water Supply – Water supply must be evaluated with respect to quantity, reliability, and cost. The criteria for quantity is that the plan must be sufficient to meet all projected needs in the planning period. The criteria for reliability is that it meet municipal and industrial needs 100 percent of the time, and agricultural needs 75 percent of the time. The criteria for cost is that the projected cost be reasonable to meet the projected needs.
- Environmental Issues – Environmental considerations must be examined with respect to environmental water needs, wildlife habitat, cultural resources, and bays and estuaries. The criteria for environmental water flows and wildlife habitat is that stream conditions must meet permit requirements for diversions that currently have permits. For projects that require permit acquisition the project will provide adequate environmental instream flows for aquatic habitat. Projects should be sited to avoid known cultural resources, if possible. Flows to bays and estuaries should meet expected permit conditions. (It should be noted that the Brazos River does not have an estuary, so bay and estuary inflow requirements are expected to be low).
- Impacts on Other State Water Resources – The criteria recommends a follow-up study by the RWPG if any significant impacts are anticipated on other state water resources.
- Threats to Agriculture and Natural Resources – The criteria requires that the planning group identify any potential impact, compare the impact to the proposed benefit of the plan, and make recommendations.
- Equitable Comparison of Feasible Strategies – This is achieved by the equal application of criteria across different water development plans.
- Interbasin Transfers – The planning group may consider interbasin transfers as a supply option. The criteria require that the participating entities recognize and follow Texas Water Code requirements for expected permitting requirements.
- Impacts from Voluntary Redistribution – The criteria requires that any potential third party social or economic impacts from voluntary redistribution of water rights be identified and described.
- Other Criteria – Texas Water Development Board (TWDB) allows the RWPG to adopt other criteria. As of June 2000, no other criteria have been adopted by the Brazos G RWPG.

The following sections discuss the methods and procedures used to develop the information needed to evaluate the strategies and compare them to the criteria.

5A.1.3 Engineering

A procedure was developed to maintain equal and consistent consideration of various design and cost variables across differing management options. These were planning level estimates only, and did not reflect detailed site-specific design work, nor any extensive optimization and selection of design variables. These procedures standardized the consideration of the following design and costing issues as closely as possible, given the varying scope and magnitude of differing projects. For each option, major cost components were determined at the outset. Estimates of volume of water and rate of delivery needed were developed from the supply-demand comparisons presented in Section 4, if directly applicable. Volumes necessary to meet shortages were estimated, and both average annual and peak rates of projected delivery were calculated. Average annual rates were adjusted to reflect pump station downtime due to maintenance activities. Transmission and treatment facilities were sized based on peak rates of delivery. Water source and delivery locations were determined, considering source and destination elevations, surrounding land use, and other geographic considerations. Further details on engineering factors considered are presented in Volume II of this report, Section 5A.1.

5A.1.4 Cost Estimates

The cost estimates of this study are expressed in three major categories: (1) construction costs or capital (structural) costs, (2) other (non-structural) project costs, and (3) annual costs. Construction costs are the direct costs incurred in constructing facilities, such as those for materials, labor, and equipment. "Other" project costs include expenses not directly associated with construction activities of the project, such as costs for engineering, legal counsel, land acquisition, contingencies, environmental studies and mitigation, and interest during construction. Capital costs and other project costs comprise the total project cost. Operation and maintenance, energy costs, and debt service payments are examples of annual costs. Major components that may be part of a preliminary cost estimate are listed in Table 5A.1-2. Details regarding all cost components are presented in Volume II of this report, Section 5A.

To estimate capital costs, tables of unit costs for each major component in the capital costs were developed through an internal review of bid documents and project cost audits of projects that HDR has implemented in the past. The cost tables report all-inclusive costs to construct, including the construction, infrastructure and control equipment, and all other materials, labor, and installation costs. Unit costs were developed for pump stations, intake structures, pipelines, wells, reservoir structures, channel dams and any other structural component called for in a water supply option.

Table 5A.1-2.
Major Project Cost Categories

Capital Costs (Structural Costs)	*Other Project Costs (Non-Structural Costs)*
1. Pump Stations 2. Pipelines 3. Water Treatment Plants 4. Water Storage Tanks 5. Off-Channel Reservoirs 6. Well Fields a. Injection b. Recovery c. ASR Wells 7. Dams and Reservoirs 8. Relocations 9. Water Distribution 10. Other Items	1. Engineering (Design, Bidding and Construction Phase Services, Geotechnical, Legal, Financing, and Contingencies) 2. Land and Easements 3. Environmental - Studies and Mitigation 4. Interest During Construction ***Annual Project Costs*** 1. Debt Service 2. Operation and Maintenance (excluding pumping energy) 3. Pumping Energy Costs 4. Purchase Water Cost (if applicable)

As previously mentioned, "other" (non-structural) project costs are costs incurred in a project that are not directly associated with construction activities. These include costs for engineering, legal counsel, financing, contingencies, land, easements, surveying and legal fees for land acquisition, environmental and archaeology studies, permitting, mitigation, and interest during construction. These costs are added to the capital costs to obtain the total project cost. A standard percentage applied to the capital costs is used to calculate a combined cost that includes engineering, financial, legal services, and contingencies. Details are presented in Volume II.

Annual costs are those that the project owner can expect to incur if the project is implemented. These costs include repayment of borrowed funds (debt service), operation and maintenance costs of the project facilities, pumping power costs, and water purchase costs, when applicable.

Debt service is the estimated annual payment that can be expected for repayment of borrowed funds based on the total project cost, an assumed finance rate, and the finance period in years. As specified in TWDB Exhibit B, Section 1.71, debt service for all projects was calculated assuming an annual interest rate of 6 percent and a repayment period of 40 years for reservoir projects and 30 years for all other projects. The debt service factor of 0.06646 or 0.07265 for 40- or 30-year repayment periods is applied, respectively, to the total estimated project costs.

Operation and maintenance costs for dams, pump stations, pipelines, and well fields (excluding pumping power costs) include labor and materials required to operate the facilities and provide for regular repair and/or replacement of equipment. In accordance with TWDB guidelines, operation and maintenance costs are calculated at 1 percent of the total estimated construction costs for pipelines, distribution, facilities, tanks and wells, at 1.5 percent of the total estimated construction costs for dams and reservoirs, and at 2.5 percent for intake and pump stations. Water treatment plant operation and maintenance costs were based on treatment level and plant capacity. The operation and maintenance costs include labor, materials, replacement of equipment, process energy, building energy, chemicals, and pumping energy.

In accordance with TWDB guidelines, power costs are calculated on an annual basis using the appropriate calculated power load and a power rate of $0.06 per kWh. The amount of energy consumed is based upon the pumping horsepower required.

The raw water purchase cost, if applicable, is included if the water supply option involves purchase of raw or treated water from an entity. This cost varies by source.

A cost estimate summary for each individual option is presented with total capital costs, total project costs, and total annual costs. The level of detail is dependent upon the characteristics of each option. Additionally, the cost per unit of water involved in the option is reported as costs per acft and cost per 1,000 gallons of water developed. The individual option cost tables specify the point within the region at which the cost applies (e.g., raw water at the lake, treated water at the municipal and industrial demand center, or elsewhere as appropriate).

5A.1.5 Methods Used to Investigate Environmental Effects of Proposed Regional Water Management Strategies

The Regional Water Planning Guidelines (31 TAC 357.7) require that each regional water management strategy includes an evaluation of environmental factors, specifically effects on environmental water needs, natural resources, wildlife habitat, cultural resources, and upstream development on bays, estuaries, and arms of the Gulf of Mexico. These factors were evaluated for each of the proposed water management strategies according to the level of description and engineering design information provided. Details regarding the methodology to investigate environmental water needs, instream flow needs, impact on bays and estuaries, and fish and wildlife habitat are detailed in Volume II of this report.

5A.1.6 Agricultural Water Management Strategies

New firm water supplies cannot be developed for irrigated agriculture, because the cost of development far exceeds the value of the water in irrigated production. The assumption is made that the available groundwater resources are already fully exploited. Cloud seeding and brush control for water yield are the only potential new supplies of water for irrigated agriculture, but a firm yield cannot be assigned to these practices. Without any firm supply of water, agricultural producers will have to reduce the irrigation and confined livestock demands through a variety of conservation and other management practices.

5A.1.6.1 Water Conservation and Irrigation System Conversion

Water conservation is the most practical and feasible option, and increasing the efficiency of the irrigation systems is the strategy that offers the most practical and feasible solution with any certainty. To conserve water in irrigated agriculture, the assumption is made that the crop is fully irrigated, so that the water conserved remains in the aquifer or surface source and is available to meet other agricultural needs. The cost of water conservation per acft has to be within the production value range when it is used to meet a shortage. For example, a producer will not incur a conservation cost of $50/acft unless the production value of the water on another field with a shortage is less than $50/acft. The additional cost of delivery of the conserved irrigation water has to be taken into account. The producer will be most likely to adopt water conservation practices when a positive return will result, as with lower energy and labor costs. The tradeoff is with the higher cost of a more efficient irrigation system.

The efficiency of irrigation systems is dependent on the individual producer operation and on the inherent nature of the type of irrigation. The efficiency of irrigation is measured as the ratio of the water actually used by the crop to the total water delivered from the source. The major water losses are to deep percolation below the effective root zone of the crop (over-irrigation), water runoff from the field, and evaporation of the water to the atmosphere. As an extreme example, only 30 percent of the water applied from a high-pressure sprinkler on a very hot, very windy afternoon may ever reach the surface for infiltration. In general, gated pipe surface irrigation is 40 to 70 percent efficient, side roll sprinkler irrigation is 50 to 75 percent efficient, and a low-pressure center pivot with drop nozzles is about 90 percent efficient. The various forms of microirrigation (drip tape, microsprinklers, drip emitters, etc) are 90 to 95 percent efficient. Good management and ideal conditions will increase the efficiency.

Three scenarios were considered for an economic analysis of conversion of irrigation systems for water conservation. One scenario was conversion of a system that is 75 percent efficient to a system that is 90 percent efficient, such as conversion of a side roll system to an efficient center pivot or the renozzling of a center pivot with impact sprinkers to low-pressure drop nozzles. The second scenario was the conversion of a system that is 50 percent efficient to a system that is 75 percent efficient. This could be the conversion from a gated pipe to a side roll or adoption of cutback or surge irrigation with the gated pipe. The third scenario was the conversion of a 50 percent efficient system to a 90 percent efficient system.

Several assumptions were made for simplicity. A 25-year economic analysis period was selected, which is in the range for wells, pumps, pipelines, and the major equipment. Two interest rates were used—10 percent for conventional loan and 2 percent for a low-interest loan. Constant dollars (no inflation) were used. A linear series of annual values was used for the analysis. A capital recovery factor was calculated for the capital investment and operating (variable) costs for taxes, insurance, repair, and maintenance were calculated based on typical values. Water conservation results in lower energy costs for pumping and pressurization, and decreased labor is typically results from conversion of gated pipe and side roll irrigation to center pivot irrigation. Decreased energy and labor costs were taken into account.

For purposes of illustration, 130 acres were converted from one system to another in the scenarios. The cost of meeting the water shortage is expressed in dollars per acft of conserved water. Peanuts and cotton are the target crops for the analysis, although high-value horticultural crops and high-quality forage crops would also fit the scenarios. The crop requires 15-acre inches per acre to meet the yield objective. At 50 percent efficiency, 30 inches of water will be delivered from the source to the crop; at 75 percent efficiency, 20 inches of water will be delivered; and at 90 percent efficiency, 16.67 inches of water will be delivered. For a full season of irrigation, plus limited rainfall and carryover soil moisture reserve, the water conserved by conversion to more efficient irrigation is calculated. Conversion from 75 to 90 percent efficiency conserves 36.08 acft for the 130 acres, conversion from 50 to 75 percent conserves 108.33 acft, and conversion from 50 to 90 percent conserves 144.41 acft.

Three levels of cost for conversion of irrigation systems were selected: $300/acre, $500/acre, and $700/acre. The actual costs for a field will depend on proximity to water supply, existence or absence of pipelines, field layout, "farmability," and other factors. Taxes and insurance were calculated at 2 percent and repair and maintenance were calculated at 5 percent. The water was available at no cost. The annual cost of labor saved was estimated at $6545 for conversion to a center pivot from gated pipe or side roll system. The energy cost was calculated as $2.00 per acre-inch, based on typical values for pressure requirements, flow requirements, and electricity cost. Other costs were neglected.

The results of the cost analysis are shown in Table 4-81. As shown in the table, at conventional financing, the economically feasible options are limited. The options are for a low investment cost ($300/acre) or conversion to a 90 percent efficient irrigation system. With low interest financing, the options are more economically feasible, and include all three low investment cost scenarios and conversion of 50 percent efficient irrigation systems to 70 or 90 percent efficient systems, although an increased cost of production will be incurred by the producer.

For planning purposes, the amount of water conserved will be 0.23 acft/acre for conversion of a system that is 75 percent efficient to one that is 90 percent efficient; 0.83 for conversion from 50 percent efficient to 75 percent efficient, and 1.11 for conversion from 50 percent efficient to 90 percent efficient.

Table 5A.1-3.
Cost/Value of Irrigation Water Conservation
from Increasing the Efficiency of Irrigation Systems
(130 acre system)

Investment Cost (dollars/acre)	Water Conserved (acft)	Cost	
		10% finance ($/acft)	2% finance ($/acft)
300	30.48	10.65	20.65
	108.33	-40.86	33.98
	144.41	20.66	40.65
500	30.48	-119.18	-53.94
	108.33	-84.1	-40.6
	144.41	-11.77	-33.94
700	30.48	-249.02	-27.83
	108.33	-127.35	-14.27
	144.41	-44.21	-7.83

5A.1.6.2 Strategies for Meeting Irrigation Shortages

As stated previously, there are no new economically feasible water supply options for irrigated and confined animal production. Shortages must be met through agricultural management strategies detailed in the following section. Following are general water conservation strategies for irrigation.

- Plant crops that require less water and/or decrease yield objective. The cost is variable, depending on current markets. Irrigated wheat requires irrigation in winter and spring, but may have very little economic return unless wheat is used for stocker pasture in fall and mid-winter. Sorghum requires less water than cotton, but the economic return is typically much less. Peanuts require water over a 120 to 150 day growing period, but the economic return is significant. Silage corn may requires only one or two irrigations and is harvested in early July, but requires a nearby market and a compatible irrigation system. Plant populations may be decreased to make maximum use of rainfall during the growing season, but the anticipated economic benefit is usually less. An economic analysis of these strategies is very region specific, and probably specific to individual agricultural producers.
- Convert to more efficient irrigation systems for delivery and application efficiency (up to $1000/acre to convert from gated pipe to center pivot; $500/acre to convert side roll to center pivot; about $1000/acre to install drip irrigation;
- Use soil moisture and potential evapotranspiration irrigation scheduling (cost of about $3.50/acre, but significant technology transfer will be required)
- Convert to dryland production or reduce the number and amount of irrigation (deficit irrigation). Water production functions (relationship between yield and water applied) are poorly known and are not generally used for major crops in Brazos G. With water production functions, producers select the optimum timing and amount of irrigation water to apply to achieve the maximum yield for a unit of water. In general terms, this strategy allows moisture stress, but the stress is managed to have the least impact on the final yield or quality. Incorporation of deficit irrigation strategies based on plant and soil measurements will require additional research and technology transfer for each crop in each cropping region.
- Develop new crops and crop varieties. Plants that are able to perform with less water are essential. Possibilities include earlier maturing crops, crops with a higher ratio of yield to non-yield components (harvest index), crops that can be planted earlier in the growing season to take advantage of stored soil moisture and spring rains, crops with improved rooting characteristics, new crops for an area, and varieties that simply perform better than similar varieties under dry conditions. Significant research and technology transfer will be required on a regional basis.
- Use cultural practices that suppress evaporation. Mulches are effective in reducing evaporation from the soil surface. Plastic mulches may be used in vegetable production and dust mulches formed with cultivation are used extensively in row crop production.
- Increase infiltration. Off-season cultural practices that increase infiltration (i.e., reduce runoff) of winter precipitation are very effective. For many crops, half of the total water requirements may be available from a full soil moisture profile in the upper meter or so of root zone.

5A.1.7 Funding and Permitting by State Agencies of Projects Not in the Regional Water Plan

Senate Bill 1 requires water supply projects be consistent with approved regional water plans to be eligible for TWDB funding and to obtain TNRCC permits. Regarding TNRCC permitting, the Texas Water Code[2] provides that the TNRCC shall grant an application to appropriate surface water, including amendments to existing permits, only if the proposed action addresses a water supply need in a manner that is consistent with an approved regional water plan. TNRCC may waive this requirement if conditions warrant.

For TWDB funding, the Texas Water Code[3] states that the TWDB may provide financial assistance to a water supply project only after TWDB determines that the needs to be met by the project will be addressed in a manner that is consistent with the appropriate regional water plan. The TWDB may waive this provision if conditions warrant.

The Brazos G Regional Water Planning Group has considered the variety of actions and permit applications that may come before the TNRCC and the TWDB and does not want to unduly constrain projects or applications for small amounts of water that may not be specifically included in the adopted regional water plan. “Small amounts of water” is defined as involving no more than 1,000 acft/yr, regardless of whether the action is for a temporary or long term action. The Brazos G RWPG provides direction to TNRCC and TWDB regarding appropriations, permit amendments, and projects involving small amounts of water that will not have a significant impact on the region’s water supply as follows: such projects are consistent with the regional water plan, even though not specifically recommended in the plan.

The Brazos G RWPG also provides direction to the TWDB regarding financial assistance for repair and replacement of existing facilities. Water supply projects not involving the development of or connection to a new water source are consistent with the regional water plan, even though not specifically mentioned in the adopted plan.

[2] Texas Water Code, Section 11.134
[3] Texas Water Code, Section 16.053(j)

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Table 5A.2-1.
Cities with Projected Deficits and Above Average Per Capita Demands

City	County	Projected Shortages				Per Capita Water Use			
		2030 (acft/yr)	2030 Percent of Demand	2050 (acft/yr)	2050 Percent of Demand	Year 2030 Per Capita (gpcd)	Percent Over Basin Average	Year 2050 Per Capita (gpcd)	Percent Over Basin Average
Holland	Bell	87	23%	94	25%	160	14.6%	150	10.8%
Morgans Point Resort	Bell	584	67%	648	69%	190	35.9%	175	29.1%
Salado (CDP)	Bell	228	19%	478	33%	390	179.1%	385	184.1%
Meridian	Bosque	218	65%	281	70%	151	8.2%	150	10.8%
Bryan	Brazos	0	0%	3,106	16%	146	4.5%	143	5.5%
College Station	Brazos	6,381	21%	12,295	44%	236	68.7%	235	73.6%
Baird	Callahan	149	52%	118	46%	150	7.2%	146	7.7%
Fort Hood (P)	Coryell	52	1%	0	0%	194	38.8%	189	39.5%
Gatesville	Coryell	6,102	83%	8,121	89%	168	20.2%	166	22.5%
Stephenville	Erath	0	0%	0	0%	160	14.5%	155	14.4%
Stamford (P)	Jones	748	63%	959	75%	224	60.3%	220	62.4%
Groesbeck	Limestone	756	83%	874	85%	153	9.5%	149	9.9%
Sweetwater	Nolan	0	0%	0	0%	259	85.3%	255	88.1%
Palo Pinto	Palo Pinto	82	100%	83	100%	157	12.1%	151	11.8%
Glen Rose	Somervell	300	44%	432	53%	175	25.3%	171	26.2%
Florence	Williamson	136	40%	212	51%	145	3.6%	149	10.1%
Georgetown	Williamson	8,151	47%	18,535	67%	155	10.8%	151	11.8%
Round Rock (P)	Williamson	12,157	39%	21,543	54%	166	19.0%	182	34.3%
Taylor	Williamson	0	0%	1,507	19%	147	5.2%	145	7.0%

Table 5A.3-1.
Wastewater Reuse Potential

City	County	Projected Shortages				Wastewater Treatment Plant Return Flow and Reuse						
		2030 (acft/yr)	2030 Percent of Demand	2050 (acft/yr)	2050 Percent of Demand	Estimated WWTP Return Flow (acft/yr)	25% Return Flow for Reuse (acft/yr)	Current Water Reuse	Total Reuse (acft/yr)	Irrigation Reuse (acft/yr)	Industrial Reuse (acft/yr)	Other Reuse (acft/yr)
Holland	Bell	87	23%	94	25%	44	11	N	—			
Morgans Point Resort	Bell	584	67%	648	69%	22	6	Y	0.6	0.6		
Salado (CDP)	Bell	228	19%	478	33%	19	5	N	—			
Meridian	Bosque	218	65%	281	70%	115	29	N	—			
Valley Mills	Bosque	77	23%	83	21%	62	16	N	—			
Walnut Springs	Bosque	41	12%	43	11%	60	15	Y	15.0	14.1		0.9
Bryan	Brazos	0	0%	3,106	16%	6,050	1,513	N	—			
College Station	Brazos	6,381	21%	12,295	44%	5,446	1,362	N	—			
Baird	Callahan	149	52%	118	46%	250	63	N	—			
Copperas Cove	Coryell	426	5%	3,296	30%	1,680	420	N	—			
Fort Hood	Coryell	52	1%	0	0%	28	7	N	—			
Gatesville	Coryell	6,102	83%	8,121	89%	984	246	N	—			
Cisco	Eastland	185	34%	119	25%	391	98	N	—			
Haskell	Haskell	526	100%	538	100%	426	107	N	—			
Alvarado	Johnson	72	10%	220	26%	230	58	N	—			
Grand View	Johnson	160	72%	190	75%	184	46	N	—			
Keene	Johnson	1,149	88%	1,495	91%	234	59	N	—			
Stamford	Jones	748	63%	959	75%	321	80	N	—			
Groesbeck	Limestone	756	83%	874	85%	190	48	N	—			
Sweetwater	Nolan	0	0%	0	0%	1842	461	Y	—			
Palo Pinto	Palo Pinto	82	100%	83	100%	21	5	N	—			
Glen Rose	Somervell	300	44%	432	53%	187	47	Y	0.1	0.1		
Abilene	Taylor	0	0%	0%	0%	16,000	4,000	Y	3300	3300		
Merkel	Taylor	294	43%	355	48%	414	104	N	—			
Florence	Williamson	136	40%	212	51%	42	11	Y	NA			
Georgetown	Williamson	8151	47%	18,535	67%	1,554	389	Y	25.0	25.0		
Granger	Williamson	129	34%	224	48%	110	28	N	—			
Hutto	Williamson	265	67%	550	81%	21	5	N	—			
Round Rock	Williamson	12,157	39%	21,543	54%	3,828	957	Y	1100	1100		
Taylor	Williamson	0	0%	1,507	19%	1,609	402	N	—			

Table 5A.4-3.
Environmental Issues: Expanded Use of Existing Sources

Water Management Options	*Implementation Measures*	*Environmental Water Needs/Instream Flows*	*Bays and Estuaries*	*Fish and Wildlife Habitat*	*Cultural Resources*	*Threatened and Endangered Species*[1]
Coordinated Use of Lake Leon with Local Groundwater	Reduced Reservoir Releases	Negligible Impacts	Negligible Impacts	Possible Low Impacts	Possible Low Impacts	Negligible Impacts
Coordinate Use of Lake Fort Phantom Hill and Hubbard Creek Reservoir	Fewer and Smaller Releases from Reservoirs	Possible Moderate Impacts (less dissolved oxygen)[1]	Negligible Impact	Possible Moderate Impacts (Unique Stream Segment Downstream)	Negligible Impact	Negligible Impact
Coordinate Use of Lakes Sweetwater, Trammel, and Oak Creek	Changed Reservoir Releases and Small Scale Pipeline	Possible Moderate Impact[1]	Negligible Impact[2]	Possible Impact[2]	Possible Low Impact	Possible Impact on Black Capped Vireo[3]

[1] Assumes decrease in average annual instream flows; does not account for cumulative effects of decreased regional stream flows.

[2] Impacts would be variable depending on changes in reservoir pool elevations. Possible negative impacts would be possible for bottomland hardwood forests. Positive or negative impacts would be possible for wetlands.

[3] Federally listed endangered species: Black-capped vireo (*Vireo atricapillus*).

Table 5A.7-5.
Environmental Issues for Enhancement of Reservoir Yield Options: Brazos G Regional Water Planning Group Proposed Water Management Strategies (Group A)

Water Management Options	*Implementation Measures*	*Environmental Water Needs / Instream Flows*	*Bays and Estuaries*	*Fish and Wildlife Habitat*	*Cultural Resources*	*Threatened and Endangered Species*
Increase Storage and/or Reallocation in Lake Leon	Raise Dam and Reallocation Regulatory Process[1]	Possible Moderate Impacts[2]	Possible Impacts	Possible Impact[3]	Possible Impacts	Possible Low Impact on Interior Least Tern, Whooping Crane [4]
Diversion to Lake Stamford from California Creek	Intake Structure and Pipeline	Possible Low Impact[3]	Possible Low Impact[3]	Possible Low Impact[4]	Possible Low Impact	Negligible Impact
Supplement Lake Fort Phantom Hill with Groundwater from Seymour	Well Field and Pipeline	Possible Low Impact	Negligible Impact	Possible Low Impact[4]	Possible Low Impact	Negligible Impact
New Impoundment Below Lake Fort Phantom Hill	Dam, Intake Structure and Pipeline	Possible Moderate Impact3	Negligible Impact	Possible Moderate Impact to Riparian Vegetation (Potential Unique Steam Segment Downstream)[3]	Negligible Impact	Negligible Impact
Diversion from Sweetwater Creek to Lake Sweetwater	Impoundment Dam, Pump Station and Pipeline	Possible Moderate Impacts (less dilution, less dissolved oxygen)[3]	Negligible Impact	Probable Moderate Impact	Possible Low Impact	Possible Low Impact on Black-capped Vireo[4]
Diversion from Battle Creek to Lake Cisco	Enlarge Storage and Pumping Capacity of Diversion Structure	Possible Low Impact	Negligible Impact	Possible Low Impact	Possible Low Impact	Negligible Impact

1 May affect area inundated and downstream flows.

2 Assumes decrease in average annual instream flows; does not account for cumulative effects of decreased regional stream flows.

3 Impacts variable depending on changes in reservoir pool elevations; possible negative impacts to bottomland hardwood forest; possible positive or negative impacts to wetlands.

4 Federally listed endangered species include Black-capped vireo (*Vireo atricapillus)*; Interior least tern (*Sterna antillarum athalassos*); Whooping crane (*Grus americana*).

Table 5A.8-2.
Chloride Removal Rates for Each Control Option
(Average Daily Load, Tons per Day)

Option	***Shallow Well Recovery***		***Kiowa Peak Reservoir***	***Total Potential Chloride Removal***	***Low Flow Diversion***	***Comments***
	Dove Creek Salt Flats	***Croton Creek Watershed[1]***				
1.1	388	-	-	388	No	No low flow diversion; salt accumulated in-stream not recovered; chloride removal rate of 388 tons per day may not be achievable.
1.2	388	75	-	463	No	No low flow diversion; salt accumulated in-stream not recovered; chloride removal rate of 463 tons per day may not be achievable.
2.1	388	-	50	438	No	No low flow diversion; salt accumulated in-stream not recovered; chloride removal rate of 438 tons per day may not be achievable.
2.2	388	75	50	513	No	No low flow diversion; salt accumulated in-stream not recovered; chloride removal rate of 513 tons per day may not be achievable.
3	388	-	-	388	Yes	Low flow diversion offers higher removal efficiency than Options 1.1 – 2.2; salt accumulated in the channel is captured; the low flow diversion also offers some redundancy if the shallow well recovery wells are subject to power outages or other events that would stop their operation.

[1] Including Hot Springs Canyon and Short Croton Creek

Table 5A.19-2.
Environmental Issues: Conjunctive Use of Brazos Alluvium Aquifer

Water Management Option	***Implementation Measures***	***Environmental Water Needs/ Instream Flows***	***Bays and Estuaries***	***Fish and Wildlife Habitat***	***Cultural Resources***	***Threatened and Endangered Species***
Conjunctive Use of Brazos Alluvium Aquifer (Brazos and Robertson Counties)	Construction of three diversion channels to distribute (20 miles) unappropriated flows (10,000 to 100,000 acft/yr) to infiltration basins for recharge by percolation; Installation of well field to pump stored water to river to offset upstream diversions	Possible low impact on downstream aquatic habitat due to lower flood flows	Possible low impact for 100,000 acft/yr diversion rate; Investigation of impacts needed	Probable low impact on wetlands and riparian bottomlands from construction of channels and ponds	Possible low impact	Possible moderate impact on Houston toad, Bald eagle

5B.1 Bell County Water Supply Plan

Table 5B.1-1 lists each water user group in Bell County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.1-1.
Bell County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Bartlett	17	2	Projected surplus
City of Belton	2,076	1,665	Projected surplus
City of Harker Heights	2,378	1,739	Projected surplus
City of Holland	(87)	(94)	Projected shortage – see plan below
City of Killeen	2,779	1,455	Projected surplus
City of Little River-Academy	(127)	(124)	Projected shortage – see plan below
City of Morgans Point Resort	(584)	(648)	Projected shortage – see plan below
City of Nolanville	74	31	Projected surplus
City of Rogers	25	11	Projected surplus
Salado (CDP)	(228)	(478)	
Salado Total	(1,404)	(2,029)	Projected shortage – see plan below
City of Temple	6,765	6,222	Projected surplus
City of Troy	(255)	(274)	Projected shortage – see plan below
Fort Hood	(3,098)	(3,098)	Projected shortage – see plan below
County-Other	5,197	3,801	Projected surplus
Manufacturing	(7,315)	(8,395)	Projected shortage – see plan below
Steam-Electric	(11,200)	(11,200)	Projected shortage – see plan below
Mining	19	9	Projected surplus
Irrigation	4,744	4,763	Projected surplus
Livestock	0	0	No projected needs

[1] From Tables 4-1 and 4-2, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.1.1 City of Bartlett

The City of Bartlett is in both Bell and Williamson Counties, consequently, it's water demand and supply values are split into the tables for each county. Bartlett's water supply is groundwater from both the Trinity and Edwards Aquifers. No future shortages are projected for the City of Bartlett and no changes in water supply are recommended.

5B.1.2 City of Belton

The City of Belton has a contract to purchase water from the Brazos River Authority from Lake Belton. Belton contracts with Bell County WCID No. 1 to divert, treat, and deliver water from Lake Belton to the City. No shortages are projected for the City of Belton and no changes in water supply are recommended.

5B.1.3 City of Harker Heights

The City of Harker Heights has a contract to purchase water from the Brazos River Authority from Lake Belton. Harker Heights contracts with Bell County WCID No. 1 to divert, treat, and deliver water from Lake Belton to the City. No shortages are projected for the City of Harker Heights and no changes in water supply are recommended.

5B.1.4 City of Holland

5B.1.4.1 Description of Supply

- Source: Surface Water – Contract with Central Texas WSC from Stillhouse Hollow Reservoir. Ground Water - Trinity Aquifer
- Estimated Reliable Supply: 289 acft per year
- System Description: The City of Holland purchases treated water from Central Texas WSC. The City has a well that is used to supplement the purchased water.

5B.1.4.2 Options Considered

The City of Holland has a shortage of 87 acft per year in 2030, which is about 23 percent of demand. Table 5B.1-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Holland's shortage.

Table 5B.1-2.
Water Management Strategies Considered for the City of Holland

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	19	$35,000/year	$574[2]
Wastewater Reuse (Section 5A.3)	11	$44,400	$326[3]
Little River Reservoir (Section 5A.14)	169,800	$361,065,000	$150[4]
Southwest Bell County Regional Water System	-	[5]	[5]
Voluntary Redistribution from In-County Source, Transmission and Treatment through existing facilities	100	$65,000/year[6]	$650[6]
No Action	-	$3,693,000[7]	$42,443[7]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Table 5A.3.
4 Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
5 Costs estimate is pending input from consultants to CTWSC and BRA.
6 Estimated treated water cost. Costs dependent on location and size of project.
7 Economic impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.1.4.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Holland:

- Voluntary Redistribution from In-County Source, Transmission and Treatment through existing Central Texas WSC facilities; source will probably be Lake Stillhouse Hollow; City of Holland will need to negotiate for about 100 acft per year of water from either BRA or contract holder at lake.

5B.1.4.4 Costs

Costs of the Recommended Plan for the City of Holland.

a. Voluntary Redistribution:
   - Cost Source: estimated wholesale treated water rate
   - Date to be Implemented: By year 2015
   - Annual Cost: $65,000 per year

     The annual cost of $65,000 per year was calculated by multiplying the City of Holland need of 100 acft per year by an estimated wholesale water rate of $650/acft.

Table 5B.1-3.
Recommended Plan Costs by Decade for the City of Holland

Plan Element	2000	2010	2020	2030	2040	2050
Voluntary Redistribution						
Projected Surplus/(Shortage) (acft/yr)	111	42	(44)	(87)	(96)	(94)
Supply From Plan Element (acft/yr)	-	-	100	100	100	100
Annual Cost ($/yr)	-	-	$65,000	$65,000	$65,000	$65,000
Unit Cost ($/acft)	-	-	$650	$650	$650	$650

5B.1.5 City of Killeen

The City of Killeen contracts with Bell County WCID No. 1 to divert, treat, and deliver water from Lake Belton to the City. No shortages are projected for the City of Killeen and no changes in water supply are recommended.

5B.1.6 City of Little River-Academy

5B.1.6.1 Description of Supply

- Source: Ground Water - Trinity Aquifer. Surface Water purchased from the City of Temple
- Estimated Reliable Supply: 359 acft per year
- System Description: Surface water supply supplements ground water supply. The City of Temple supplies treated surface water to Little River – Academy by transmission pipeline.

5B.1.6.2 Options Considered

The City of Little River-Academy has a projected shortage of 127 acft per year in 2030, which is about 26 percent of demand. Table 5B.1-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Little River-Academy shortage.

Table 5B.1-4.
Water Management Strategies Considered for the City of Little River-Academy

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
Additional Water Conservation (Section 5A.2)	24	$13,950/year	$574[2]
Little River Reservoir (Section 5A.14)	169,800	$361,065,000	$150[3]
No Action	-	$5,340,000[4]	$42,443[4]
Southwest Bell County Regional Water System	-	[5]	[5]
Voluntary Redistribution from In-County Source, Transmission and Treatment through existing facilities	150	$79,600/year[6]	$530[6]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
4 Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.
5 Costs estimate is pending input from consultants to CTWSC and BRA.
6 Source of Cost Estimate: City of Temple wholesale water rates.

5B.1.6.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Little River-Academy:

- Voluntary Redistribution from City of Temple. Little River-Academy would meet shortage by buying an additional 150 acft per year from the City of Temple. The existing facilities have adequate capacity to deliver the additional water.

5B.1.6.4 Costs

Costs of the recommended plan for the City of Little River-Academy to meet 2030 shortages are:

a. Voluntary Redistribution from City of Temple:
   - Cost Source: City of Temple's wholesale water rates
   - Date to be Implemented: By year 2010
   - Annual Cost: $79,600 per year

   The Annual Cost of $79,600 per year is based upon The City of Temple's wholesale water rates of approximately $1.75 per 1,000 gallons for the first 1 million gallons per month and $1.65 per 1,000 gallons for any additional water in that month.

Table 5B.1-5.
Recommended Plan Costs by Decade for the City of Little River-Academy

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Voluntary Redistribution						
Projected Surplus/(Shortage) (acft/yr)	104	19	(85)	(127)	(141)	(124)
Supply From Plan Element (acft/yr)	-	150	150	150	150	150
Annual Cost ($/yr)	-	$79,600	$79,600	$79,600	$79,600	$79,600
Unit Cost ($/acft)	-	$530	$530	$530	$530	$530

5B.1.7 City of Morgan's Point Resort

5B.1.7.1 Description of Supply

- Source: Surface Water from City of Temple
- Estimated Reliable Supply: 291 acft per year
- System Description: The City of Morgan's Point Resort has a contract with the City of Temple to purchase treated surface water. The City of Temple serves Morgan's Point Resort through a transmission pipeline.

5B.1.7.2 Options Considered

The City of Morgan's Point Resort has a projected shortage of 584 acft per year in 2030, which is about 67 percent of demand. Table 5B.1-6 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Morgan's Point Resort shortage.

5B.1.7.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Morgan's Point Resort:

- Voluntary Redistribution from City of Temple. Morgan's Point Resort would meet its shortage through purchase of an additional 650 acft per year from the City of Temple. The existing facilities do not have adequate capacity to deliver the additional water. The City of Temple would incur the capital costs to build the additional facilities. Morgan's Point Resort would pay for the water through Temple's rate structure.

Table 5B.1-6.
Water Management Strategies Considered for the City of Morgan's Point Resort

Option	Yield	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	44	$25,000/year	$574[2]
Wastewater Reuse (Section 5A.3)	22	$24,000/year	$326[3]
Little River Reservoir (Section 5A.14)	169,800	$361,965,000	$150[4]
Southwest Bell County Regional Water System	-	[5]	[5]
Voluntary Redistribution from In-County Source, Transmission and Treatment through existing facilities	650	$351,000/year[6]	$539[6]
No Action	-	$24,787,000[7]	$42,443[7]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Table 5A.3.
4 Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
5 Costs estimate is pending input from consultants to CTWSC and BRA.
6 Source of Cost Estimate: City of Temple's wholesale water rates.
7 Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.1.7.4 Costs

Costs of the recommended plan for the City of Morgan's Point Resort to meet 2030 shortages are:

a. Voluntary Redistribution from City of Temple:
- Cost Source: The City of Temple's water rates
- Date to be Implemented: By year 2005
- Annual Cost: $351,000 per year

The Annual Cost of $351,000 per year is based upon The City of Temple's wholesale water rates of approximately $1.75 per 1,000 gallons for the first 1 million gallons per month and $1.65 per 1,000 gallons for any additional water in that month.

5B.1.8 City of Nolanville

The City of Nolanville contracts with Bell County WCID No. 1 and Bell County WCID No. 3 to divert, treat, and deliver water from Lake Belton to the City. No shortages are projected for Nolanville and no changes in water supply are recommended.

Table 5B.1-7.
Recommended Plan Costs by Decade for the City of Morgan's Point Resort

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Voluntary Redistribution						
Projected Shortage (acft/yr)	(138)	(316)	(481)	(584)	(644)	(648)
Supply From Plan Element (acft/yr)	650	650	650	650	650	650
Annual Cost ($/yr)	-	$351,000	$351,000	$351,000	$351,000	$351,000
Unit Cost ($/acft)	-	$539	$539	$539	$539	$539

5B.1.9 City of Rogers

The City of Rogers purchases treated surface water from Central Texas WSC. No shortages are projected for the City of Rogers and no changes in water supply are recommended.

5B.1.10 Salado WSC (CDP and County-Other)

The Salado area is provided water by Salado Water Supply Corporation. For water supply estimates, the TWDB uses the population that resides or is projected to reside in the Salado Census Data Place (CDP) area and the TWDB projections are reported in Table 2-1 (population) and Table 2-3 (water demand). However, Salado WSC serves a larger population than is reflected in Table 2-1. These other customers served by Salado WSC are accounted for in the County-Other category for Bell County. Projections were made of population and water demand for most of the entities that make up the County-Other category (i.e., water supply corporations, water districts, and others). To get a clear understanding of Salado WSC water demand projections, the Salado CDP projections and the Salado WSC from County-Other must be combined.

5B.1.10.1 Description of Supply

Salado WSC currently relies on Edwards Aquifer groundwater for its water supply. The groundwater supply in Bell County is estimated to have a reliable supply of about 3,484 acft/yr (Table 3-14) based on pumpage and aquifer response in the drought of the 1950's. This groundwater supply was apportioned to all current users based on 1997 reported use and Salado WSC is estimated to have a reliable groundwater supply of about 992 acft/yr. Salado WSC also has a contract with the Brazos River Authority for 1,600 acft/yr from Lake Stillhouse Hollow.

There are no facilities in place to allow Salado WSC to use this supply, consequently this supply is not shown in the demand/supply tables (Table 4-2), in accordance with TWDB rules.

In order to get a clear understanding of Salado's demand/supply situation, water demands for both the Salado CDP and County-Other category along with their water supply are reported in Table 5B.1-8. As shown in Table 5B.1-8, the shortage in 2030 for supplies with infrastructure in place is 1,404 acft/yr. With the Lake Stillhouse Hollow water, there is no shortage in 2030 and the shortage in 2050 is 429 acft/yr. TWDB rules require that plans be developed for year 2030 shortages; if infrastructure is needed to utilize contracted supplies, then include that infrastructure in the plan.

Table 5B.1-8.
Water Demands and Supply for Salado WSC (CDP and County-Other)

	2000	2010	2020	2030	2040	2050
Water Demand (acft/yr)						
Salado CDP (Table 2-3)	755	910	1,057	1,220	1,356	1,470
Salado from County-Other[1]	145	463	801	1,105	1,384	1,480
Total Demand	**900**	**1,373**	**1,858**	**2,325**	**2,740**	**2,950**
Water Supply (acft/yr)						
Groundwater	921	921	921	921	921	921
Surplus/(Shortage) with Groundwater Only	**21**	**(452)**	**(937)**	**(1,404)**	**(1,819)**	**(2,029)**
BRA Contract	1,600	1,600	1,600	1,600	1,600	1,600
Surplus/(Shortage) with BRA Contract	**1,621**	**1,148**	**663**	**196**	**(219)**	**(429)**

[1] See www.brazosgwater.org web site for County-Other water demands by entity.

5B.1.10.2 Options Considered

Table 5B.1-9 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the Salado WSC (CDP and County-Other) shortage.

5B.1.10.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of Salado (WSC and County-Other):

- Implement Regional Water System to Utilize BRA Contract

Table 5B.1-9.
Water Management Strategies Considered for Salado WSC (CDP and County-Other)

Option	Yield	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	61	$35,014/year	574[2]
Little River Reservoir (Section 5A.14)	169,800	$361,065,000	150[3]
Southwest Bell County Regional Water System	-	[4]	[4]
Transmission Pipeline from CTWSC to Salado WSC	1,600	$8,296,000	$687
No Action	-	$9,677,000[5]	$42,443[5]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
4 Cost estimate is pending input from consultants to CTWSC and BRA.
5 Economic impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.1.10.4 Costs

Costs of the recommended plan for the Salado WSC (CDP and County-Other) to meet 2030 shortages are:

a. Implement Regional Water System to Utilize BRA contract:
   - Cost Source: HDR Preliminary Cost Estimate for Planning Purposes. Costs based on a standalone system with raw water intake at Stillhouse Hollow Reservoir, a water treatment facility in the proximity of the Stillhouse Hollow Dam, and treated water transmission lines to connect to the Salado WSC system. Approximately 15,000 ft. of 14-in. diameter transmission pipeline and a 3 MGD capacity water treatment plant are the main capital cost components.
   - Date to be Implemented: by 2008
   - Total Project Cost: $8,296,000
   - Total Annual Cost: $1,100,000

A preliminary engineering study is currently being performed by consultants to BRA and CTWSC. The proposed regional system would have a raw water intake and water treatment plant at the Stillhouse Hollow Reservoir and treated water transmission lines delivering water to communities in southwestern Bell County and northern Williamson County.

Once this study is available, the costs for water service to Salado WSC can be amended and will probably be lower than shown in Table 5B.1-9.

5B.1.11 City of Temple

The City of Temple obtains raw water primarily from the Leon River, to which it holds a run-of-the-river permit. This permit from the TNRCC gives the City the right to divert water from the river but not to store it. The City also has contracted for stored water from BRA in Lake Belton. No shortages are projected for the City of Temple and no changes in water supply are recommended.

Table 5B.1-10.
Recommended Plan Costs by Decade for Salado WSC (CDP and County-Other)

Plan Element	2000	2010	2020	2030	2040	2050
Regional Water System						
Projected Surplus/(Shortage) (acft/yr)	21	(452)	(937)	(1,404)	(1,819)	(2,029)
Supply From Plan Element (acft/yr)	0	1,600	1,600	1,600	1,600	1,600
Annual Cost ($/yr)	*	*	*	*	*	*
Unit Cost ($/acft)	*	*	*	*	*	*
* Cost is pending outcome of preliminary engineering study being performed by others.						

5B.1.12 City of Troy

5B.1.12.1 Description of Supply

- Source: Surface Water from City of Temple from Leon River; Ground Water from Trinity Aquifer
- Estimated Reliable Supply: 194 acft/yr
- System Description: The City of Troy receives water from the City of Temple at two meter locations. Two ground water wells supplement the system.

5B.1.12.2 Options Considered

The City of Troy has a projected shortage of 255 acft per year in 2030, which is about 58 percent of demand. Table 5B.1-11 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Troy shortage.

5B.1.12.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Troy:

- Voluntary Redistribution from Temple. The City of Troy would meet their shortage by buying an additional 300 acft per year from the City of Temple. The existing facilities have adequate capacity to deliver the additional water.

Table 5B.1-11.
Water Management Strategies Considered for the City of Troy

Option	*Yield*	*Approximate Cost[1]* Total	*Approximate Cost[1]* Unit ($/acft)
Additional Water Conservation (Section 5A.2)	22	$12,886/year	$574[2]
Little River Reservoir (Section 5A.14)	169,800	$361,065,000	$150[3]
Voluntary Redistribution from City of Temple (Treated Water Cost)	$300	$159,000/year[6]	$530[6]
No Action	-	$10,823,011[4]	$42,443[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
[4] Economic Impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.
[5] Costs estimate is pending input from consultants to CTWSC and BRA.
[6] Source of Cost Estimate: City of Temple's wholesale water rates.

5B.1.12.4 Costs

Costs of the recommended plan for the City of Troy to meet 2030 shortages are:

a. Voluntary Redistribution from City of Temple.
   - Cost Source: The City of Temples water rates
   - Date to be Implemented: By Year 2005
   - Annual Cost: $159,000 per year

   The Annual Cost of $159,000 per year is based upon the City of Temple's wholesale water rates of approximately $1.75 per 1,000 gallons for the first 1 million gallons per month and $1.65 per 1,000 gallons for any additional water in that month.

Table 5B.1-12.
Recommended Plan Costs by Decade for the City of Troy

Plan Element	2000	2010	2020	2030	2040	2050
Voluntary Redistribution						
Projected Shortage (acft/yr)	(41)	(117)	(199)	(255)	(272)	(274)
Supply From Plan Element (acft/yr)	-	300	300	300	300	300
Annual Cost ($/yr)	-	$159,000	$159,000	$159,000	$159,000	$159,000
Unit Cost ($/acft)	-	$530	$530	$530	$530	$530

5B.1.13 Fort Hood

The U.S. Department of the Army (Fort Hood) has a water right to store and divert 12,000 acft in Lake Belton. Technically, the Army could, in any single year, divert up to 12,000 acft, however, the yield available from their permitted storage volume is 3,336 acft/yr. This water supply has been divided evenly between Coryell County and Bell County and the Army contracts with the City of Gatesville (Coryell County) and Bell County WCID No. 1 to divert, treat, and deliver this water to Fort Hood. Based on their firm water supply, shortages are shown for Fort Hood in each county. The shortages are based on projected demands with full staffing level and reserve units called to active duty, which will probably be an infrequent event and of temporary duration. In which case, the Army should be able to arrange to purchase additional treated water through the City of Gatesville and Bell County WCID No. 1 using raw water supplies contracted to other entities. No change in Fort Hood's water supply situation is recommended.

5B.1.14 County-Other

No shortages are projected for County-Other entities and no changes in water supply are recommended.

5B.1.15 Manufacturing

5B.1.15.1 Options Considered

Manufacturing in Bell County has a projected shortage of 7,315 acft per year in 2030, which is about 96 percent of demand. Table 5B.1-13 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for manufacturing in Bell County.

5B.1.15.2 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage for manufacturing in Bell County:

- Voluntary Redistribution from Municipal Use

Table 5B.1-13.
Water Management Strategies Considered for Manufacturing in Bell County

Option	Yield (acft)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation	380	$218,120	$574
Wastewater Reuse	1,825	$7,022,000	$326
Voluntary Redistribution from Municipal Use	7,315	$0	$0
No Action	-	$1,254,546,000[1]	$171,503[1]

[1] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.1.15.3 Costs

Water supply for manufacturing in Bell County is obtained by purchase from a city or water supply corporation or from private wells operated by the manufacturing entity. Most of the cities and the rural area in Hill County have surplus supplies through the year 2050. New manufacturing facilities would be expected to locate where existing water supplies are available, such as near a city or within the service area of an existing water supply corporation. In which case, the cost of a water supply to a new facility would be as a retail customer to the City and as such, no cost is listed for meeting this demand.

5B.1.16 Steam-Electric

There is no water supply in Bell County dedicated to steam-electric use. Steam-Electric in Bell County has a projected demand of 11,200 acft/yr, consequently, the shortage is also 11,200 acft/yr.

5B.1.16.1 Options Considered

Table 5B.1-14 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the shortage for Steam-Electric in Bell County.

Table 5B.1-14.
Water Management Strategies Considered for Steam-Electric Use in Bell County

Option	Yield	Approximate Cost	
		Total	Unit ($/acft)
Additional Water Conservation	550	$316,000	$574
Wastewater Reuse	11,200	$42,326,000	$326
Voluntary Redistribution from Municipal Use	11,200	$1,792,000[1]	$160[1]
No Action	-	$52,657,000[2]	$4,701[2]

1 Costs dependent on location and size of project.
2 Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.1.16.2 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage for Steam-Electric Use in Bell County:

- Voluntary Redistribution from Municipal Use

5B.1.16.3 Costs

Costs of the recommended plan for Steam-Electric Use in Bell County to meet 2030 shortages are:

a. Voluntary Redistribution from Municipal Use:
   - Cost Source: Estimate of wholesale cost of water
   - Date to be Implemented: By Year 2010
   - Annual Cost: $1,792,000 per year

   The Annual Cost of $1,792,000 is based upon multiplying the desired amount of water, 11,200 acft, by the estimated wholesale water rate of $160 per acft for raw water delivered to a steam-electric plant.

Table 5B.1-15.
Recommended Plan Costs by Decade for Steam-Electric Use in Bell County

Plan Element	2000	2010	2020	2030	2040	2050
Voluntary Redistribution From Municipal Use						
Projected Shortage (acft/yr)	(0)	(11,200)	(11,200)	(11,200)	(11,200)	(11,200)
Supply From Plan Element (acft/yr)	-	11,200	11,200	11,200	11,200	11,200
Annual Cost ($/yr)	-	$1,792,000	$1,792,000	$1,792,000	$1,792,000	$1,792,000
Unit Cost ($/acft)	-	$160	$160	$160	$160	$160

5B.1.17 Mining

No shortages are projected for Bell County Mining and no changes in water supply are recommended.

5B.1.18 Irrigation

No shortages are projected for Bell County Irrigation and no changes in water supply are recommended.

5B.1.19 Livestock

No shortages are projected for Bell County Livestock and no changes in water supply are recommended.

5B.2 Bosque County Water Supply Plan

Table 5B.2-1 lists each water user group in Bosque County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.2-1.
Bosque County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Clifton	200	76	Projected surplus; possible regional provider – see plan below
City of Meridian	(218)	(281)	Projected shortage – see plan below
City of Valley Mills	(77)	(83)	Projected shortage – see plan below
City of Walnut Springs	(41)	(43)	Projected shortage – see plan below
County-Other	(992)	(1,194)	Projected shortage – see plan below
Manufacturing	(704)	(903)	Projected shortage – see plan below
Steam-Electric	(5,600)	(5,600)	Projected shortage – see plan below
Mining	(136)	(235)	Projected shortage – see plan below
Irrigation	8,585	8,619	Projected surplus
Livestock	31	31	Projected surplus

[1] From Tables 4-3 and 4-4, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.2.1 City of Clifton

5B.2.1.1 Description of Supply

The City of Clifton obtains its water supply from groundwater from the Trinity Aquifer and from surface water from the North Bosque River. The City owns and operates five wells that currently serve as the City's primary water supply. The City of Clifton owns water rights on the North Bosque River and has recently completed the construction of the first phase of a new surface water supply project. This new project diverts water from the North Bosque River and impounds it for storage in an off-channel reservoir. The project was planned to provide for additional phases to enlarge the project as demand increases. Based on the estimated availability of groundwater to the City and the firm yield of the new surface water supply project, the City of Clifton has a surplus of 200 acft/yr in the year 2030 and 76 acft/yr in the year 2050. The ability to expand the project results in the City being a potential regional provider of water to other Bosque County entities.

5B.2.2 City of Meridian

5B.2.2.1 Description of Supply

The City of Meridian obtains its water supply from groundwater from the Trinity Aquifer. The City owns and operates three wells that serve as the City's sole source water supply. Based on the available groundwater supply, the City is projected to have a shortage of 218 acft/yr in the year 2030 and 281 acft/yr in the year 2050. Due to declining well levels, the City has been planning to implement a surface water supply project to supplement its existing groundwater supply.

5B.2.2.2 Options Considered

Table 5B.2-2 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for the City of Meridian.

Table 5B.2-2.
Water Management Strategies Considered for the City of Meridian

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	17	$22,960/year	$574[2]
Wastewater Reuse (Section 5A.3)	42	$170,000	$326[3]
Meridian Off-Channel Reservoir (Section 5A.15)	574	$7,472,000[3]	$1,395[4]
Bosque County Supply From Lake Whitney (Section 5A.16)	1,475	$25,872,000[4]	$1,753[5]
No Action		$9,257,000[6]	$42,443[6]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Section 5A.3.
4 Source of Cost Estimate: Section 5A.15.
5 Source of Cost Estimate: Section 5A.16.
6 Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.2.2.3 Water Supply Plan

In 1998, the City of Meridian performed a water supply study and the Meridian Off-Channel Reservoir Project was recommended as the most economical alternative. Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Meridian:

- Construct Off-Channel Reservoir by year 2010 to supply an additional 574 acft/yr.

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Wastewater Reuse to supply an additional 42 acft/yr.

5B.2.2.4 Costs

Costs of the recommended plan for the City of Meridian to meet 2030 shortages are:

a. Meridian Off-Channel Reservoir:
   - Cost Source: Section 5.15
   - Date to be Implemented: before 2010
   - Total Project Cost: $7,472,000
   - Annual Cost: $400,000

   Annual cost assumes joint participation from other water supply entities such as Mustang Valley WSC. Annual cost for Meridian is prorated share (50%) based on projected 2050 shortage.

Table 5B.2-3.
Recommended Plan Costs by Decade for the City of Meridian

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Off-Channel Reservoir						
Projected Shortage (acft/yr)	(174)	(177)	(196)	(218)	(246)	(281)
Quantity Available (acft/yr)	281	281	281	281	281	281
Annual Cost ($/yr)	$400,000	$400,000	$400,000	$129,000	$129,000	$129,000
Unit Cost ($/acft)	$1,395	$1,395	$1,395	$449	$449	$449

5B.2.3 City of Valley Mills

5B.2.3.1 Description of Supply

The City of Valley Mills obtains its water supply from groundwater from the Trinity Aquifer. The City owns and operates two wells that serve as the sole source supply. Based on the groundwater supply available, the City of Valley Mills is projected to have a shortage of 77 acft/yr in the year 2030 and 83 acft/yr in the year 2050.

5B.2.3.2 Options Considered

Table 5B.2-4 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for the City of Valley Mills.

Table 5B.2-4.
Water Management Strategies Considered for City of Valley Mills

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	8	$8,610/year	$574[2]
Wastewater Reuse (Section 5A.3)	17	$69,000	$326[3]
Clifton System to Valley Mills (Section 5A.20)	242	$416,000[3]	$1,558[4]
Bosque County Supply From Lake Whitney (Section 5A.16)	1,475	$25,872,000[4]	$1,753[5]
Clifton Surface Water System Expansion	400	$1,936,000[5]	$480[6]
No Action		$3,268,000[6]	$42,443[6]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Table 5A.20-3 (prorated for Valley Mills).
4 Source of Cost Estimate: Table 5A.16-3.
5 Source of Cost Estimate: Based on estimated costs to enlarge dam, pump station, and treatment plant.
6 Economic impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.2.3.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Valley Mills:

- Clifton supply to Valley Mills by year 2010 to supply an additional 100 acft/yr. The City of Clifton would have sufficient capacity to serve the City of Valley Mills through the year 2030.

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Clifton Surface Water System Expansion by the year 2040 to continue to supply 100 acft/yr. In order to maintain supply to the City of Valley Mills, the City of Clifton's surface water supply system is projected to be required to be expanded to meet Clifton's needs as well as the entities outside of Clifton.
- Wastewater Reuse to supply an additional 17 acft/yr.

5B.2.3.4 Costs

Costs of the Recommended Plan for the City of Valley Mills to meet 2030 shortages are:

a. Clifton Supply to Valley Mills:
   - Cost Source: Section 5.20, Table 5.20-3
   - Date to be Implemented: before 2010
   - Total Project Cost: $416,000 (Prorated for Valley Mills)
   - Annual Cost: $129,000

Table 5B.2-5.
Recommended Plan Costs by Decade for the City of Valley Mills

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Clifton Supply to Valley Mills						
Projected Shortage (acft/yr)	(92)	(86)	(79)	(77)	(78)	(83)
Quantity Available (acft/yr)	-	100	100	100	100	100
Annual Cost ($/yr)	-	$155,800	$155,800	$119,400	$119,400	$119,400
Unit Cost ($/acft)	-	$1,558	$1,558	$1,194	$1,194	$1,194

5B.2.4 City of Walnut Springs

5B.2.4.1 Description of Supply

The City of Walnut Springs obtains its water supply from groundwater from the Trinity Aquifer. The City owns and operates two wells that serve as its sole source supply. Based on the groundwater availability in the Trinity Aquifer, the City of Walnut Springs is projected to have a shortage of 41 acft/yr in the year 2030 and 43 acft/yr in the year 2050.

5B.2.4.2 Options Considered

The potential water supply options to meet the projected shortages for the City of Walnut Springs are not economical, relative to the costs of other alternatives in the region, due to the proximity of Walnut Springs to available supplies and other regional providers. Table 5B.2-6 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for the City of Walnut Springs.

Table 5B.2-6.
Water Management Strategies Considered for the City of Walnut Springs

Option	*Yield (acft/yr)*	*Approximate Cost[1]*	
		Total	*Unit ($/acft)*
Additional Water Conservation (Section 5A.2)	4	$8,610/year	$574[2]
Meridian Off-Channel Reservoir (Section 5A.20)	50	$1,797,000	$4,767[3]
Bosque County Supply From Lake Whitney (Section 5A.16)	43	$2,477,000	$6,101[4]
No Action	-	$1,740,000[5]	$42,443[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Table 5A.20-3.
[4] Source of Cost Estimate: Table 5A.16-3, (prorated for Walnut Springs).
[5] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.2.3.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Walnut Springs:

- Meridian Off-Channel Reservoir by year 2010 to supply an additional 50 acft/yr. The City of Walnut Springs is planned to participate with the City of Meridian in the implementation of the Meridian Off-Channel Reservoir and installation of a transmission pipeline to Meridian to serve its needs through the year 2050.

5B.2.3.4 Costs

Costs of the Recommended Plan for the City of Walnut Springs to meet 2030 and 2050 shortages are:

a. Meridian Off-Channel Reservoir to Walnut Springs:
    - Cost Source: Section 5.15, Table 5.15-2

- Date to be Implemented: before 2010
- Total Project Cost: $1,797,000
- Annual Cost: $205,000

Table 5B.2-7.
Recommended Plan Costs by Decade for the City of Walnut Springs

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Meridian Off-Channel Reservoir to Walnut Springs						
Projected Shortage (acft/yr)	(55)	(50)	(45)	(41)	(40)	(43)
Quantity Available (acft/yr)	-	50	50	50	50	50
Annual Cost ($/yr)	-	$238,350	$238,350	$238,350	$155,800	$155,800
Unit Cost ($/acft)	-	$4,767	$4,767	$4,767	$3,116	$3,116

5B.2.5 County-Other

5B.2.5.1 Description of Supply

Bosque County-Other obtains its water supply from groundwater from the Trinity Aquifer. None of the County-Other entities utilize surface water as a water supply. Based on the available groundwater supply in the Trinity Aquifer, County-Other is projected to have a shortage of 992 acft/yr in the year 2030 and 1,194 acft/yr in the year 2050. Some of the larger water supply entities included in County-Other are Childress Creek WSC and Mustang Valley WSC. Potential surface water supplies may be available through the City of Clifton and future development by the City of Meridian to supplement their existing groundwater supplies.

5B.2.5.2 Options Considered

The potential water supply options to meet the projected shortages for the County-Other entities include the City of Clifton providing service to Childress Creek WSC, Mustang Valley WSC, and the City of Meridian providing service to Mustang Valley WSC. Each of these entities is located relatively close in proximity to the respective cities. Table 5B.2-8 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for Bosque County-Other.

Table 5B.2-8.
Water Management Strategies Considered for Bosque County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	97	$56,000/yr	$574[2]
Meridian Off-Channel Reservoir to Mustang Valley WSC (Section 5A.20)	250	$1,610,000	$2,278[3]
Clifton System to Mustang Valley WSC (Section 5A.20)	228	$2,562,000	$2,517[4]
Clifton System to Childress Creek WSC (Section 5A.20)	165	$827,000	$1,558[5]
Bosque County Supply From Lake Whitney (Section 5A.16)	1,475	$25,782,000	$1,753[6]
No Action	-	$17,936,000[7]	$18,080[7]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Table 5A.20-4 (expanded to serve County-Other and MVWSC).
[4] Source of Cost Estimate: Table 5A.20-3 (expanded to serve County-Other and MVWSC).
[5] Source of Cost Estimate: Table 5A.20-3.
[6] Source of Cost Estimate: Table 5A.16-3.
[7] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.2.5.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage of the County-Other:

- Meridian Off-Channel Reservoir by year 2010 to supply 250 acft/yr to County-Other. The Mustang Valley WSC is planned to participate with the City of Meridian in the implementation of the Meridian Off-Channel Reservoir and install a transmission pipeline to Meridian to serve its needs through the year 2050.
- Clifton System to Childress Creek WSC by year 2010 to supply 165 acft/yr. The Childress Creek WSC is planned to purchase water from the City of Clifton for supply through the year 2030.
- Clifton System to Mustang Valley WSC by year 2010 to supply an additional 228 acft/yr to County-Other.
- Clifton Surface Water System Expansion by the year 2030 to continue to supply 393 acft/yr to County-Other. In order to maintain supply to the County-Other entities, the City of Clifton's surface water supply system is projected to be required to be expanded to meet Clifton's needs as well as the entities outside of Clifton.
- Bosque County Supply from Lake Whitney by the year 2010 to supply 878 acft/yr to County-Other entities through a regional system. Includes voluntary redistribution of water supply from the BRA System.

5B.2.5.4 Costs

Costs of the Recommended Plan for County-Other to meet 2030 shortages are:

a. Meridian Off-Channel Reservoir to Mustang Valley WSC and County-Other:
   - Cost Source: Section 5A.20
   - Date to be Implemented: before 2010
   - Total Project Cost: $1,610,000

b. Clifton System to Childress Creek WSC:
   - Cost Source: Section 5A.20
   - Date to be Implemented: before 2010
   - Total Project Cost: $827,000

c. Clifton System to Mustang Valley WSC and County-Other:
   - Cost Source: Section 5A.20
   - Date to be Implemented: before 2010
   - Total Project Cost: $2,562,000

b. Bosque County Supply from Lake Whitney:
   - Cost Source: Section 5A.20
   - Date to be Implemented: before 2030
   - Total Project Cost: $25,782,000

5B.2.6 Manufacturing

5B.2.6.1 Description of Supply

Water supply for manufacturing in Bosque County is obtained by purchase from a city or water supply corporation or from private wells operated by the manufacturing entity. New manufacturing facilities would be expected to locate where existing water supplies are available, such as near a City or within the service area of an existing water supply corporation. Based on the available groundwater supply, Manufacturing is projected to have a shortage of 704 acft/yr in the year 2030 and 903 acft/yr in the year 2050.

5B.2.6.2 Options Considered

Table 5B.2-10 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for Bosque Manufacturing.

Table 5B.2-9.
Recommended Plan Costs by Decade for Bosque County-Other

Plan Element	2000	2010	2020	2030	2040	2050
Projected Shortage (acft/yr)	(1,028)	(996)	(1,001)	(992)	(998)	(1,194)
Meridian Off-Channel Reservoir MVWSC						
Quantity Available (acft/yr)	-	250	250	250	250	250
Annual Cost ($/yr)	-	$570,000	$570,000	$570,000	$378,000	$378,000
Unit Cost ($/acft)	-	$2,280	$2,280	$2,280	$1,512	$1,512
Chifton to Childress Creek WSC						
Quantity Available (acft/yr)	-	228	228	228	228	228
Annual Cost ($/yr)	-	$355,000	$355,000	$355,000	$272,000	$272,000
Unit Cost ($/acft)	-	$1,557	$1,557	$1,557	$1,193	$1,193
Clifton to MVWSC						
Quantity Available (acft/yr)	-	165	165	165	165	165
Annual Cost ($/yr)	-	$415,000	$415,000	$415,000	$212,000	$212,000
Unit Cost ($/acft)	-	$2,515	$2,515	$2,515	$1,285	$1,285
Bosque Co. Supply from Lake Whitney						
Quantity Available (acft/yr)		551	551	551	551	551
Annual Cost ($/yr)	-	$966,000	$966,000	$966,000	$267,000	$267,000
Unit Cost ($/acft)	-	$1,753	$1,753	$1,753	$485	$485
Total						
Quantity Available (acft/yr)		1194	1194	1194	1194	1194
Annual Cost ($/yr)	-	$2,306,000	$2,306,000	$2,306,000	$1,129,000	$1,129,000
Unit Cost ($/acft)	-	$1,931	$1,931	$1,931	$946	$946

Table 5B.2-10.
Water Management Strategies Considered for Bosque Manufacturing

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Wastewater Reuse (Section 5A.3)	97	$392,000	$326[2]
Meridian Off-Channel Reservoir (Section 5A.15)	574	$7,472,000	$1,395[3]
Clifton Surface Water System Expansion	400	$1,936,000	$480[4]
Voluntary Redistribution – BRA System	903	$21,000	$23[5]
No Action	-	$152,352,000[6]	$216,409[6]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Table 5A.15.
[4] Source of Cost Estimate: Based on estimated cost to enlarge dam, pump station, and treatment plant.
[5] Source of Cost Estimate: Table 5A.3.
[6] Economic impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.2.6.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage for manufacturing:

- Voluntary Redistribution of water the BRA System (Lake Whitney) to supply an additional 903 acft/yr of raw water for manufacturing use.

5B.2.6.4 Costs

Costs of the Recommended Plan for County-Other to meet 2030 shortages are:

a. Voluntary Redistribution from BRA System
   - Cost Source: Section 5A.3
   - Date to be Implemented: before 2010
   - Total Project Cost: $21,000/yr

Table 5B.2-11.
Recommended Plan Costs by Decade for Manufacturing

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Voluntary Redistribution from BRA System						
Projected Shortage (acft/yr)	(424)	(514)	(607)	(704)	(803)	(903)
Quantity Available (acft/yr)	-	903	903	903	903	903
Annual Cost ($/yr)	-	$21,000	$21,000	$21,000	$21,000	$21,000
Unit Cost ($/acft)	-	$23	$23	$23	$23	$23

5B.2.7 Steam-Electric

5B.2.7.1 Description of Supply

Steam-electric demand in Bosque County is associated with the Southern Energy, Inc. power generation plant located near Lake Whitney. Southern Energy, Inc. has contracted with the Brazos River Authority for water supply from Lake Whitney. The current contract for water is a short-term contract that expires prior to the year 2010. Steam-electric is projected to have a shortage of 5,600 acft/yr in the year 2030 and 2050.

5B.2.7.2 Options Considered

Table 5B.2-12 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for steam-electric.

Table 5B.2-12.
Water Management Strategies Considered for Bosque County Steam-Electric

Option	*Yield (acft/yr)*	*Approximate Cost[1]*	
		Total	*Unit ($/acft)*
Voluntary Redistribution – BRA System	5,600	$129,000/yr	$23
No Action	-	$26,328,000[3]	$4,701[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.6.
[3] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.2.7.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage for manufacturing:

- Voluntary Redistribution of water the BRA System (Lake Whitney) to supply an additional 5,600 acft/yr of raw water for steam-electric use.

5B.2.7.4 Costs

Costs of the Recommended Plan for County-Other to meet 2030 shortages are:

a. Voluntary Redistribution – BRA System
   - Cost Source: Section 5A.6
   - Date to be Implemented: before 2010
   - Total Project Cost: $129,000/yr

Table 5B.2-13.
Recommended Plan Costs by Decade for Bosque County Steam-Electric

Plan Element	2000	2010	2020	2030	2040	2050
Voluntary Redistribution – BRA System						
Projected Shortage (acft/yr)	0	(5600	(5600)	(5600)	(5600)	(5600)
Quantity Available (acft/yr)	0	5600	5600	5600	5600	5600
Annual Cost ($/yr)	-	$129,000	$129,00	$129,000	$129,000	$129,000
Unit Cost ($/acft)	-	$23	$23	$23	$23	$23

5B.2.8 Mining

5B.2.8.1 Description of Supply

Mining is projected to have a shortage of 136 acft/yr in the year 2030.

5B.2.8.2 Options Considered

Table 5B.2-14 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for mining.

Table 5B.2-14.
Water Management Strategies Considered for Bosque County Mining

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Voluntary Redistribution – BRA System	136	$5,400	$23[2]
No Action	-	$445,000[3]	$3,273[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.6.
[3] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.2.8.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage for mining:

- Voluntary Redistribution of water from the BRA System to supply an additional 136 acft/yr of raw water for mining use.

5B.2.8.4 Costs

Costs of the Recommended Plan for Mining to meet 2030 shortages are:

a. Voluntary Redistribution – BRA System:
   - Cost Source: Section 5A.6
   - Date to be Implemented: before 2010
   - Total Project Cost: $5,400/yr

Table 5B.2-15.
Recommended Plan Costs by Decade for Bosque County Mining

Plan Element	2000	2010	2020	2030	2040	2050
Voluntary Redistribution – BRA System						
Projected Shortage (acft/yr)	(9)	(42)	(89)	(136)	(183)	(235)
Quantity Available (acft/yr)	-	235	235	235	235	235
Annual Cost ($/yr)	-	$5,400	$5,400	$5,400	$5,400	$5,400
Unit Cost ($/acft)	-	$23	$23	$23	$23	$23

5B.2.9 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.2.10 Livestock

No shortages are projected for Livestock and no changes in water supply are recommended.

5B.3 Brazos County Water Supply Plan

Table 5B.3-1 lists each water user group in Brazos County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.3-1.
Brazos County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Bryan	89	(3,106)	Projected shortage – see plan below
City of College Station	(6,381)	(12,295)	Projected shortage – see plan below
Texas A&M University	0	0	No Projected Needs
County-Other[2]	61	637	Projected surplus
Manufacturing	195	128	Projected surplus
Steam-Electric	756	756	Projected surplus
Mining	16	12	Projected surplus
Irrigation	10,106	10,869	Projected surplus
Livestock	0	0	No Projected Needs

[1] From Tables 4-5 and 4-6, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.
[2] Wickson Creek SUD has notified the Brazos G RWPG that it will need to construct facilities in order to utilize existing water supplies to meet needs in newly acquired service areas.

5B.3.1 City of Bryan

5B.3.1.1 Description of Supply

Source: Sparta and Carrizo-Wilcox Aquifers

Estimated Reliable Supply: 16,073 acft/yr

System Description: 13 wells

The City of Bryan's groundwater supply is currently limited by well capacity.

5B.3.1.2 Options Considered

The City of Bryan has a small surplus in 2030 and a projected shortage of 3,106 acft in 2050. Therefore, Bryan will need to increase its water supply prior to 2030. Table 5B.3-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Bryan's needs.

Table 5B.3-2.
Water Management Strategies Considered for the City of Bryan

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	1,102	$632,548/year	$574[2]
Wastewater Reuse (Section 5A.3)	1,918	$7,745,925	$326
Further Development of Carrizo-Wilcox Aquifer (Section 5A.17)	4,000	$7,639,000	$214[3]
Millican Reservoir -- Bundic Dam Site (Section 5A.14)	73,800	$552,000,000	$541
Millican Reservoir -- Panther Creek Site (Section 5A.14)	235,200	$1,237,000,000	$366
Peach Creek Reservoir (Section 5A.15)	12,550	$58,889,000	$455
No Action	-	$295,693,000[4]	$95,201[4]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2. Source of Cost Estimate: Section 5A.2.
3. Prorated based on unit cost.
4. Economic impact of not meeting shortage (i.e., "no action") in 2050 as estimated by TWDB.

5B.3.1.3 Water Supply Plan

For the long-term period beyond 2030, the following water management strategies are recommended:

- Further development of Carrizo-Wilcox Aquifer

5B.3.1.4 Costs

Costs of the Recommended Plan for the City of Bryan.

- Cost Source: Section 5A.17
- Date to be Implemented: By Year 2030
- Total Project Cost: $7,639,000
- Unit Cost: $214 per acft

Table 5B.3-3.
Recommended Plan Costs by Decade for the City of Bryan

Plan Element	2000	2010	2020	2030	2040	2050
Aquifer Development						
Projected Surplus/(Shortage) (acft/yr)	4,031	2,640	1,214	89	(1,375)	(3,106)
Supply From Plan Element (acft/yr)	0	0	0	4,000	4,000	4,000
Annual Cost ($/yr)	0	0	0	$856,000	$856,000	$856,000
Unit Cost ($/acft)	0	0	0	$214	$214	$214

5B.3.2 City of College Station

5B.3.2.1 Description of Supply

- **Source:** Groundwater from Carrizo-Wilcox Aquifer
- **Estimated Reliable Supply:** 15,700 acft/yr

5B.3.2.2 Options Considered

The City of College Station has a shortage of 6,381 acft per year in 2030, which is about 29 percent of demand. Table 5B.3-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of College Station's shortage.

5B.3.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of College Station:

- Further Development of Carrizo-Wilcox Aquifer

For the long-term period beyond 2030, the following additional water management strategy is recommended:

- Further Development of Carrizo-Wilcox Aquifer

Table 5B.3-4.
Water Management Strategies Considered for the City of College Station

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
Additional Water Conservation (Section 5A.2)	1,102	$632,548/year	$574[2]
Further Development of Carrizo-Wilcox Aquifer (Section 5A.17)	14,000	$20,054,000	$214[3]
Wastewater Reuse (Section 5A.3)	2,797	$11,295,799	$326
Millican Reservoir -- Bundic Dam Site (Section 5A.14)	73,800	$552,000,000	$541
Millican Reservoir -- Panther Creek Site (Section 5A.14)	235,200	$1,237,000,000	$366
Peach Creek Reservoir (Section 5A.15)	12,550	$58,889,000	$455
No Action	-	$607,475,000[4]	$95,201[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Prorated based on unit cost.
[4.] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.3.2.4 Costs

Costs of the recommended plan for the City of College Station to meet 2030 shortages are:

- Cost Source: Section 5A.17
- Date to be Implemented: By Year 2010
- Total Project Cost: $20,054,000

Table 5B.3-5.
Recommended Plan Costs by Decade for the City of College Station

Plan Element	2000	2010	2020	2030	2040	2050
Aquifer Development						
Projected Surplus/(Shortage) (acft/yr)	3,613	(169)	(3,819)	(6,381)	(9,708)	(12,295)
Supply From Plan Element (acft/yr)	0	7,000	7,000	14,000	14,000	14,000
Annual Cost ($/yr)	0	$1,498,000	$1,498,000	$1,498,000	$1,498,000	$1,498,000
Unit Cost ($/acft)	$0	$214	$214	$214	$141	$141

5B.3.3 Texas A&M University

Texas A&M University obtains about 8,600 acft/yr of groundwater from the Carrizo-Wilcox Aquifer. Texas A&M also has a contract with BRA for 6,945 acft in Lake Limestone. No infrastructure is in place for Texas A&M to utilize their surface water. No shortages are projected for Texas A&M University and no changes in water supply are recommended.

5B.3.4 County-Other

No shortages are projected for Brazos County-Other entities.

5B.3.4.1 Wickson Creek Special Utility District

Wickson Creek Special Utility District obtains its water supply from the Sparta and Carrizo-Wilcox Aquifers. The District has recently merged with Carlos WSC (Grimes County) and Wheelock WSC (Robertson County). The District Master Plan has considered options for supply to the service area and it recommends capital improvements including water transmission pipelines, pump stations, and water storage tanks. The total project cost of the capital improvement program is $4,377,000. The recommended plan costs by decade for Wickson Creek SUD are:

Table 5B.3-6.
Recommended Plan Costs by Decade for Wickson Creek SUD

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Capital Improvements Program						
Projected Surplus/(Shortage) (acft/yr)	Not Estimated					
Supply From Plan Element (acft/yr)	0	675	675	675	675	675
Annual Cost ($/yr)	$0	$334,000	$334,000	$334,000	$0	$0
Unit Cost ($/acft)	$0	$494	$494	$494	$0	$0

5B.3.5 Manufacturing

No shortages are projected for Brazos County Manufacturing and no changes in water supply are recommended.

5B.3.6 Steam-Electric

No shortages are projected for Brazos County Steam-Electric and no changes in water supply are recommended.

5B.3.7 Mining

No shortages are projected for Brazos County Mining and no changes in water supply are recommended.

5B.3.8 Irrigation

No shortages are projected for Brazos County Irrigation and no changes in water supply are recommended.

5B.3.9 Livestock

No shortages are projected for Brazos County Livestock and no changes in water supply are recommended.

5B.4 Burleson County Water Supply Plan

Table 5B.4-1 lists each water user group in Burleson County and their corresponding surplus or shortage in years 2030 and 2050.

Table 5B.4-1.
Burleson County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	2050 (acft/yr)	Comment
City of Caldwell	1,097	1,056	Projected Surplus
City of Somerville	287	296	Projected Surplus
County-Other	20,624	20,495	Projected Surplus
Manufacturing	2,420	2,397	Projected Surplus
Steam-Electric	0	0	No Demand/No Shortage
Mining	514	516	Projected Surplus
Irrigation	5,129	5,604	Projected Surplus
Livestock	7,215	7,215	Projected Surplus

[1] From Tables 4-7 and 4-8, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

Each of the water user groups in Burleson County is supplied by groundwater from the Carrizo-Wilcox Aquifer. There are significant quantities of groundwater available and, as demonstrated in Table 5B.4-1, there are sufficient municipal, industrial, and agricultural water supplies through the year 2050. No new water projects are considered for additional supply.

5B.4.1 City of Caldwell

The City of Caldwell obtains its water supply from groundwater from the Carrizo-Wilcox aquifer. The City operates three wells as its sole source of supply. This supply is projected to be sufficient through the planning period and no change in water supply is recommended.

5B.4.2 City of Somerville

The City of Somerville obtains its water supply from groundwater from the Carrizo-Wilcox aquifer. The City operates three wells as its sole source of supply. This supply is projected to be sufficient through the planning period and no change in water supply is recommended.

5B.4.3 County-Other Category

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.4.4 Manufacturing

The water supply entities for Manufacturing show a projected surplus and no changes in water supply are recommended.

5B.4.5 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.4.6 Mining

Mining water use category shows a projected surplus and no changes in water supply are recommended.

5B.4.7 Irrigation

Irrigation water use category shows a projected surplus and no changes in water supply are recommended.

5B.4.8 Livestock

Livestock water use category shows a projected surplus and no changes in water supply are recommended.

5B.5 Callahan County Water Supply Plan

Table 5B.5-1 lists each water user group in Callahan County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. In addition, long-term considerations are provided for some entities with projected surpluses.

Table 5B.5-1.
Callahan County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Baird	(149)	(118)	Projected shortage – see plan below
City of Clyde	184	236	Projected surplus
City of Cross Plains	238	269	Projected surplus
County-Other	1,478	1,526	Projected surplus
Manufacturing	0	0	No demand or supply
Steam-Electric	0	0	No demand or supply
Mining	90	105	Projected surplus
Irrigation	648	668	Projected surplus
Livestock	102	102	Projected surplus

[1] From Tables 4-9 and 4-10, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.5.1 The City of Baird

5B.5.1.1 Description of Supply

The surface water supply for the City of Baird is from Lake Baird and from the City of Abilene. Baird also receives reuse water from the City of Clyde in trade for potable water; contractual arrangements and quantities for this water supply were not available at the time of writing. These sources are insufficient to meet Baird's current and long-term shortages. For 2030, the City of Baird has a projected shortage of 149 acft, representing about 52 percent of the City's total demand.

5B.5.1.2 Options Considered

Table 5B.5-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Baird's shortage.

Table 5B.5-2.
Water Management Strategies Considered for the City of Baird

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Voluntary Redistribution from Abilene	149	$97,000/year	$650[2]
Wastewater Reuse (Section 5A.3)	63	$254,000	$326
Conservation (Section 5A.2)	14	$8,000/yr	$574
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629[3]
No Action	-	$6,324,000[4]	$42,443[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Estimated wholesale rate for treated water from Abilene.
[3] Raw water cost in the reservoir.
[4] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.5.1.3 Water Supply Plan

The following plan meets the planning criteria established by the Brazos G RWPG.

- Voluntary Redistribution from Abilene. The city currently has the existing infrastructure to obtain additional water from the City of Abilene, but does not have sufficient contractual agreements in place.
- Wastewater Reuse
- Conservation

The Breckenridge Reservoir has been recommended for consideration for long-term needs for the West Central Texas Municipal Water District, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, this source should be considered by local entities.

5B.5.1.4 Costs

Costs of the Recommended Plan for the City of Baird.

a. Voluntary Redistribution from Abilene:
   - Cost Source: estimated wholesale cost of $650/acft
   - Date to be Implemented: by 2005
   - Total Annual Cost: $97,000

b. Wastewater Reuse
   - Cost Source: Section 5A.3
   - Date to be Implemented: before 2010
   - Total Project Cost: $254,000
   - Total Annual Cost: $20,500

c. Conservation
   - Cost Source: Section 5A.2
   - Date to be Implemented: before 2010
   - Total Annual Cost: $8,000

Table 5B.5-3.
Recommended Plan Costs by Decade for City of Baird

	2000	***2010***	***2020***	***2030***	***2040***	***2050***
Projected Surplus/(Shortage) (acft/yr)	(189)	(183)	(164)	(149)	(122)	(118)
Voluntary Redistribution from Abilene						
Supply from Plan Elements (acft/yr)	0	149	149	149	149	149
Annual Costs ($/yr)	$0	$97,000	$97,000	$97,000	$97,000	$97,000
Unit costs ($/acft)	$0	$650	$650	$650	$650	$650
Wastewater Reuse						
Supply From Plan Element (acft/yr)	0	63	63	63	63	63
Annual Cost ($/yr)	$0	$20,500	$20,500	$20,500	$2,000	$2,000
Unit Cost ($/acft)	$0	$326	$326	$326	$32	$32
Conservation						
Supply From Plan Element (acft/yr)	0	14	14	14	14	14
Annual Cost ($/yr)	$0	$8,000	$8,000	$8,000	$8,000	$8,000
Unit Cost ($/acft)	$0	$574	$574	$574	$574	$574
Total New Supply (acft/yr)	0	226	226	226	226	226

5B.5.2 The City of Clyde

The City of Clyde uses surface water from local sources, and has a supply from the City of Abilene that can cover the city's projected demands. Clyde also has an arrangement with City of Baird to receive potable water in trade for reuse water. No current or future shortages are projected. Therefore, no change in water supply uses are projected or recommended.

5B.5.3 The City of Cross Plains

The City of Cross Plains uses locally available groundwater for all of its water supply and no future shortage is projected. Therefore, no changes in water supply are recommended.

5B.5.4 County-Other Category

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.5.5 Manufacturing

No Manufacturing demand exists or is projected for the county.

5B.5.6 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.5.7 Mining

Mining water use category shows a projected surplus and no changes in water supply are recommended.

5B.5.8 Irrigation

Irrigation water use category shows a projected surplus and no changes in water supply are recommended.

5B.5.9 Livestock

Livestock water use category shows a projected surplus and no changes in water supply are recommended.

5B.6 Comanche County Water Supply Plan

Table 5B.6-1 lists each water user group in Comanche County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.6-1. Comanche County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Comanche	0	0	No projected needs
City of De Leon	0	0	No projected needs
County-Other	2,072	2,087	Projected surplus
Manufacturing	0	0	No projected needs
Steam-Electric	0	0	No projected needs
Mining	6	0	No projected needs
Irrigation	(13,475)	(12,477)	Projected shortage – see plan below
Livestock	898	898	Projected surplus

[1] From Tables 4-11 and 4-12, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.6.1 City of Comanche

The City of Comanche receives its water from the Upper Leon MWD (Lake Proctor Surface Water), which has an agreement to meet Comanche's water needs. Therefore, no shortage is projected for the City of Comanche and no changes in water supply are recommended.

5B.6.2 City of DeLeon

The City of DeLeon receives its water from the Upper Leon MWD (Lake Proctor Surface Water), which has an agreement to meet DeLeon's water needs. Therefore, no shortage is projected for the City of DeLeon and no changes in water supply are recommended.

5B.6.3 County-Other

No shortage is projected for Comanche County-Other entities and no changes in water supply are recommended.

5B.6.4 Manufacturing

No shortage is projected for Comanche County Manufacturing and no changes in water supply are recommended.

5B.6.5 Steam-Electric

No shortage is projected for Comanche County Steam-Electric and no changes in water supply are recommended.

5B.6.6 Mining

No shortage is projected for Comanche County Mining and no changes in water supply are recommended.

5B.6.7 Irrigation

5B.6.7.1 Description of Supply

Surface water supplies for Comanche County Irrigation are obtained from the Leon River drainage basin, including Lake Proctor. The estimated reliable surface water supplies for irrigation are estimated at 16,274 acft in 2000, decreasing to 15,202 acft in 2010 and remaining at 15,202 acft until 2050. Groundwater supplies are obtained from the Trinity Aquifer. Groundwater supplies are estimated to be 19,890 acft until 2050. As demonstrated in Table 5B.6-1, there is a current and long-term shortage in Irrigation water supplies through the year 2050.

5B.6.7.2 Options Considered

Table 5B.6-2 lists the water management strategies that were considered for Comanche County irrigation shortages, and references the report section discussing the strategy, total project cost, and unit costs for meeting the shortage.

Table 5B.6-2.
Water Management Strategies Considered for Comanche County Irrigation

Option	*Yield (acft/yr)*	*Approximate Cost*	
		Total	*Unit ($/acft)*
Irrigation System Conversion [1]	4,600	$542,800/yr	$119
Irrigation Scheduling [1]	2,000	$100,000	$50
Brush Control	(*)	(*)	(*)
Weather Modification [2]	(*)	$500,000 to $850,000/yr	(*)
No Action	-	$1,946,000[3]	$144[3]

[1] Source of Cost Estimate: Texas Agriculture Experiment Station.
[2] Source of Cost Estimate: Section 5B.10.
[3] Economic Impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.
* Definitive yield and/or cost cannot be determined.

5B.6.7.3 Water Supply Plan

The following plan meets the planning criteria established by the Brazos G RWPG. No new water supplies are economically feasible to meet the projected shortage. Water conservation strategies in the form of conversion to irrigation systems with increased efficiency could partially meet the unmet demands. The irrigation systems in Comanche County are relatively efficient. Options are upgrade of side roll systems to center pivots, possibly some renozzling of older center pivots and conversion of hand moved sprinkler systems in pecan irrigation to microirrigation. Cultural practices such as crop selection, deficit irrigation, and conversion to dryland will account for the remainder of the water conserved (i.e., water not used).

As shown in Table 5B.6-3, conservation practices can meet about 6,600 acft/yr of the projected shortage. Apart from the conservation options presented, it is not economically feasible to meet the projected irrigation shortage in Comanche County.

5B.6.7.4 Costs

Costs of the Recommended Plan for irrigation supply are outlined in Table 5B.6-3. Costs for some options, such as brush control and weather modification, can not be directly quantified due to lack of specific data. Costs have been estimated based on generally available data outlined in the corresponding chapter in Section 5B. For irrigation system conversion, an estimated 20,000 acres of the total irrigated acreage would be upgraded to conserve 0.23 acft of water per acre of irrigated land, at an average annual cost of $119/acft. This would provide 4,600 acft annually. Irrigation scheduling with scientific methods could save an additional 10 percent of the irrigation water applied (0.1 acft/acre) at an annual cost of $5/acre for 20,000 acres.

5B.6.8 Livestock

No shortages are projected for Comanche County Livestock and no changes in water supply are recommended.

Table 5B.6-3.
Recommended Plan Costs by Decade for Comanche County Irrigation[1]

Plan Element	2000	2010	2020	2030	2040	2050
Irrigation System Conversion[2]						
Projected Shortage (acft/yr) [3]	(13,938)	(14,493)	13,981)	(13,475)	(12,973)	(12,477)
Supply from Plan Element (acft/yr)	4,600	4,600	4,600	4,600	4,600	4,600
Annual Cost ($/yr)	$542,800	$542,800	$542,800	$542,800	$542,800	$542,800
Unit Cost ($/acft)	$119	$119	$119	$119	$119	$119
Irrigation Scheduling[2]						
Supply from Plan Element (acft/yr)	2,000	2,000	2,000	2,000	2,000	2,000
Annual Cost ($/yr)	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
Unit Cost ($/acft)	$50	$50	$50	$50	$50	$50
Weather Modification[4]						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Brush Control						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Sum of Supply from Plan Elements (acft/yr)	(6,600)	(6,600)	(6,600)	(6,600)	(6,600)	(6,600)
Unmet Demand (acft/yr) [5]	(7,338)	(7,893)	(7,381)	(6,875)	(6,373)	(5,877)

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for water conserved through management practices.
2 Source of Cost Estimate: Texas Agriculture Experiment Station.
3 Total projected irrigation shortages are presented.
4 Source of Cost Estimate: Section 5B.10.
5 Apart from the conservation options presented, it is not economically feasible to meet projected irrigation shortage in Comanche County.
* Definitive yield and/or cost cannot be determined.

5B.7 Coryell County Water Supply Plan

Table 5B.7-1 lists each water user group in Coryell County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.7-1.
Coryell County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	2050 (acft/yr)	Comment
City of Copperas Cove	(426)	(3,296)	Projected shortage – see plan below
Fort Gates	0	0	No projected needs
Fort Hood	(2,365)	(2,365)	Projected shortage – see plan below
City of Gatesville	(6,102)	(8,121)	Projected shortage – see plan below
County-Other	(541)	(437)	Projected shortage – see plan below
Manufacturing	(15)	(17)	Projected shortage – see plan below
Steam-Electric	0	0	No projected needs
Mining	8	0	Projected surplus
Irrigation	903	951	Projected surplus
Livestock	555	555	Projected surplus

[1] From Tables 4-13 and 4-14, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.7.1 City of Copperas Cove

5B.7.1.1 Description of Supply

- Source: Surface Water – Contract with Bell County WCID No.1 from Lake Belton
- Estimated Reliable Supply: 7,824 acft per year
- System Description: The City of Copperas Cove purchases treated water from Bell County WCID No.1 through a transmission pipeline.

5B.7.1.2 Options Considered

The City of Copperas Cove has a shortage of 426 acft per year in 2030, which is about 5 percent of demand. Table 5B.7-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Copperas Cove's shortage.

Table 5B.7-2.
Water Management Strategies Considered for the City of Copperas Cove

Option	*Yield (acft/yr)*	*Approximate Cost*[1]	
		Total	*Unit ($/acft)*
Additional Water Conservation (Section 5A.2)	413	$237,000/year	$574[2]
Wastewater Reuse (Section 5A.3)	420	$1,696,000	$326[3]
Voluntary Redistribution	8,000	$5,200,000[4]	$650[4]
No Action	-	$40,555,000*	$95,201*

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Table 5A.3.
4 Cost Dependent upon specific project location, size, participants. The unit cost is an estimated wholesale water rate.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.7.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Copperas Cove:

- Voluntary Redistribution from Bell County entity

5B.7.1.4 Costs

Costs of the Recommended Plan for the City of Copperas Cove.

a. Voluntary Redistribution:
   - Cost Source: Estimate of the wholesale water rate
   - Date to be Implemented: Year 2025
   - Annual Cost: $2,275,000 per year

     The annual cost of $2,275,000 per year was calculated by multiplying the City of Copperas Cove need of 3500 acft per year by an estimated wholesale water of $650 per acft.

Table 5B.7-3.
Recommended Plan Costs by Decade for the City of Copperas Cove

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Voluntary Redistribution						
Projected Surplus/(Shortage) (acft/yr)	3,267	2,137	937	(426)	(1,741)	(3,296)
Supply From Plan Element (acft/yr)	-	-	-	3,500	3,500	3,500
Annual Cost ($/yr)	-	-	-	$2,275,000	$2,275,000	$2,275,000
Unit Cost ($/acft)	-	-	-	$650	$650	$650

5B.7.2 Fort Gates

No shortages are projected for Fort Gates and no changes in water supply are recommended.

5B.7.3 Fort Hood

The U.S. Department of the Army (Fort Hood) has a water right to store and divert 12,000 acft in Lake Belton. Technically, the Army could, in any single year, divert up to 12,000 acft, however, the yield available from their permitted storage volume is 3,336 acft/yr. This water supply has been divided evenly between Coryell County and Bell County and the Army contracts with the City of Gatesville and Bell County WCID No. 1 to divert, treat, and deliver this water to Fort Hood. Based on their firm water supply, shortages are shown for Fort Hood in each county. The shortages are based on projected demands with full staffing level and reserve units called to active duty, which will probably be an infrequent event and temporary duration. In which case, the Army should be able to arrange to purchase additional treated water through the City of Gatesville and Bell County WCID No. 1 using raw water supplies contracted to other entities.

5B.7.4 City of Gatesville

5B.7.4.1 Description of Supply

- Source: Surface Water – From Lake Belton
- Estimated Reliable Supply: 1,044 acft/yr
- System Description: The City of Gatesville owns and operates a regional treatment plant. Raw water is transferred from a raw water intake site at Lake Belton through

- approximately 8 miles of transmission line to the regional treatment plant from which the water enters the distribution system.

5B.1.4.2 Options Considered

The City of Gatesville has a shortage of 6,102 acft/yr in 2030, which is about 83 percent of demand. Of the 6,102 acft/yr shortage, 4,000 acft/yr is a contract with BRA that expires in 2021. Table 5B.7-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Gatesville's shortage.

Table 5B.7-4.
Water Management Strategies Considered for the City of Gatesville

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	370	$212,000/year	$574[2]
Wastewater Reuse (Section 5A.3)	246	$993,000	$326[3]
Voluntary Redistribution	8,000	$5,200,000	$650[4]
Renew Contract with BRA	4,000	$92,000	$23[5]
No Action	-	$266,367,000*	$43,652*

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Table 5A.3.
4 Cost Dependent upon specific project location, size, participants. The unit cost is an estimated wholesale water rate.
5 Source of Cost Estimate: BRA System rate.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.7.4.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Gatesville:

- Renew Contract with BRA
- Voluntary Redistribution From Bell County Entity (Treated Water Cost)

With this supply plan the City of Gatesville has an unmet need of 1,921 acft/yr in 2050. Further planning is needed to determine whether this long-term need will be met from voluntary redistribution or possible new supplies to be developed in Coryell County.

5B.7.4.4 Costs

Costs of the recommended plan for the City of Gatesville to meet 2030 shortages are:

a. Renew Contract with BRA:
- Cost Source: BRA System Rate
- Date to be Implemented: By Year 2015
- Annual Cost: $92,000 per year

The annual cost of $92,000 per year was calculated by multiplying the City of Gatesville need of 4,000 acft per year by the BRA system rate, $23 per acft

b. Voluntary Redistribution From Bell County Entity (Treated Water Cost):
- Cost Source: Estimate of wholesale water rate
- Date to be Implemented: By Year 2030
- Annual Cost: $1,430,000 per year

The annual cost of $1,430,000 per year was calculated by multiplying the City of Gatesville need of 2,200 acft per year by estimated wholesale water rate, $650 per acft

Table 5B.7-5.
Recommended Plan Costs by Decade for the City of Gatesville

Plan Element	2000	2010	2020	2030	2040	2050
Renew Contract with BRA						
Projected Surplus/(Shortage) (acft/yr)	1,970	813	(606)	(6,102)	(6,937)	(8,121)
Supply From Plan Element (acft/yr)	-	-	4,000	4,000	4,000	4,000
Annual Cost ($/yr)	-	-	$92,000	$92,000	$92,000	$92,000
Unit Cost ($/acft)	-	-	$23	$23	$23	$23
Voluntary Redistribution						
Supply From Plan Element (acft/yr)	-	-	-	2,200	2,200	2,200
Annual Cost ($/yr)	-	-	-	$1,430,000	$1,430,000	$1,430,000
Unit Cost ($/acft)	-	-	-	$650	$650	$650

5B.7.5 County-Other

5B.7.5.1 Options Considered

County-Other has a shortage of 541 acft per year in 2030, which is about 27 percent of demand. Table 5B.7-6 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the County-Other shortage.

Table 5B.7-6.
Water Management Strategies Considered for Coryell County-Other

Option	Yield (acft/yr)	Approximate Cost[1] Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	100	$57,371/year	$574[2]
Voluntary Redistribution[1]	8,000	$6,500,000	$812[3]
No Action	-	$9,782,000*	$18,080*

1 Water could be purchased from McLennan or Bell County entity, or BRA if new supplies are developed. Treatment and distribution could occur through Kempner WSC or other existing entity.
2 Source of Cost Estimate: Section 5A.2.
3 Cost Dependent upon specific project location, size, participants. The unit cost is an estimated wholesale treated water rate.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.7.5.2 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of County-Other:

- Voluntary redistribution - water could be purchased from McLennan or Bell County entity, or BRA if new supplies are developed. Treatment and distribution could occur through Kempner WSC or other existing entity.

5B.7.5.3 Costs

Costs of the recommended plan for County-Other to meet 2030 shortages are:

- Voluntary redistribution at an estimated wholesale treated water rate of $812 per acft.

Table 5B.7-7.
Recommended Plan Costs by Decade for Coryell County-Other

Plan Element	2000	2010	2020	2030	2040	2050
Voluntary Redistribution						
Projected Shortage (acft/yr)	(501)	(521)	(551)	(541)	(491)	(437)
Supply From Plan Element (acft/yr)	560	560	560	560	560	560
Annual Cost ($/yr)	$455,000	$455,000	$455,000	$455,000	$455,000	$455,000
Unit Cost ($/acft)	$812	$812	$812	$812	$812	$812

5B.7.6 Manufacturing

The Manufacturing category shows no water supply and small projected demands. The recommended plan to meet manufacturing needs is to reallocate municipal supply to manufacturing use. There would be no cost associated with this plan.

5B.7.7 Steam-Electric

Coryell County has no current or projected future demand for Steam-Electric; therefore, no recommendations have been made.

5B.7.8 Mining

No shortages are projected for Coryell County Mining and no changes in water supply are recommended.

5B.7.9 Irrigation

No shortages are projected for Coryell County Irrigation and no changes in water supply are recommended.

5B.7.10 Livestock

No shortages are projected for Coryell County Livestock and no changes in water supply are recommended.

5B.8 Eastland County Water Supply Plan

Table 5B.8-1 lists each water user group in Eastland County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Eastland County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plan described below either includes specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.8-1.
Eastland County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Cisco	(185)	(119)	Projected shortage – see plan below
City of Eastland	821	(875)	Projected shortage – see plan below
City of Gorman	0	0	Supply matches demand
City of Ranger	189	(460)	Projected shortage – see plan below
City of Rising Star	39	50	Projected surplus
County-Other	6,386	8,968	Projected surplus
Manufacturing	133	130	Projected surplus
Steam-Electric	0	0	No demand or supply
Mining	9	18	Projected surplus
Irrigation	(7,423)	(7,443)	Projected shortage – see plan below
Livestock	71	71	Projected surplus

[1] From Tables 4-15 and 4-16, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.8.1 The City of Cisco

5B.8.1.1 Description of Supply

The City of Cisco uses surface water from Lake Cisco, which has insufficient yield and is losing capacity due to sedimentation. As a result, Cisco has a current and long-term shortage; the projected shortage in 2030 is 185 acft, or about 34 percent of demand.

5B.8.1.2 Options Considered

Table 5B.8-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Cisco's shortage

Table 5B.8-2.
Water Management Strategies Considered for the City of Cisco

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
New Reservoir (Section 5A.14)	400	$6,500,000	$1,500
Battle Creek diversion to Lake Cisco (Section 5A.7.1)	500	$4,700,000	$960
Voluntary redistribution from Eastland	185	$4,500,000	$2,380
Coordinated use of Lake Leon and Groundwater (Section 5A.4.1)	1,900	$6,000,000	$650
Raise Lake Leon (Section 5A.7.1)	3,100	$20,000,000	$650
Wastewater Reuse (Section 5A.3)	98	$396,000/yr	$326
Oryx/Kerr-McGee Pipeline from Possum Kingdom Reservoir (Section 5A.20.2)	5,000	$19,500,000	$390
No Action	-	$7,852,000[2]	$42,443[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Economic Impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.8.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Cisco:

- Battle Creek diversion to supply up to an additional 500 acft/yr.
- Wastewater Reuse

5B.8.1.4 Costs

Costs of the Recommended Plan for the City of Cisco.

a. Battle Creek diversion:
- Cost Source: Section 5A.7
- Date to be Implemented: before 2010
- Total Project Cost: $4,700,000
- Annual Project Cost: $480,000

b. Wastewater Reuse
- Cost Source: Section 5A.3
- Date to be Implemented: before 2010
- Total Annual Cost: $32,000/acft

Table 5B.8-3.
Recommended Plan Costs by Decade for the City of Cisco

	2000	2010	2020	2030	2040	2050
Projected Surplus(Shortage) (acft/yr)	(316)	(268)	(225)	(185)	(149)	(119)
Battle Creek Diversion						
Supply From Plan Elements (acft/yr)	0	500	500	500	500	500
Annual Cost ($/yr)	$0	$480,000	$480,000	$480,000	$138,000	$138,000
Unit Cost ($/acft)	$0	$960	$960	$960	$276	$276
Wastewater Reuse						
Supply From Plan Element (acft/yr)	0	98	98	98	98	98
Annual Cost ($/yr)	$0	$32,000	$32,000	$32,000	$3,200	$3,200
Unit Cost ($/acft)	$0	$326	$326	$326	$32	$32
Total New Supply (acft/yr)	0	598	598	598	598	598

5B.8.2 The City of Eastland

5B.8.2.1 Description of Supply

The City of Eastland receives its surface water from a contract with Eastland County WSD. This contract expires in 2032, creating shortages thereafter.

5B.8.2.2 Options Considered

Table 5B.8-4 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for the City of Eastland.

Table 5B.8-4.
Water Management Strategies Considered for the City of Eastland

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
Extend existing contracts w/Eastland Co. WSD	1000	$650,000/yr	$650[2]
No Action	-	$37,138,000[3]	$42,443[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Estimated wholesale rate for treated water.
[3] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2050 as estimated by TWDB.

5B.8.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage of the City of Eastland:

- Extend existing contracts with Eastland Co. WSD to supply an additional 1000 acft/yr.

5B.8.2.4 Costs

Costs of the recommended plan for the City of Eastland to meet 2050 shortages are:

a. Extension of existing contracts with Eastland Co. WSD:
   - Cost Source: Estimated wholesale of $650/acft for treated water
   - Date to be Implemented: 2032
   - Total Annual Cost: $650,000

5B.8.3 The City of Gorman

5B.8.3.1 Description of Supply

The City of Gorman purchases treated water from Upper Leon River MWD and no current or future shortage is projected. Therefore, no changes in water supply are recommended.

5B.8.4 The City of Ranger

5B.8.4.1 Description of Supply

The City of Ranger is supplied with surface water from a contract with Eastland Co. WSD, which expires in 2032.

5B.8.4.2 Options Considered

Table 5B.8-5 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Ranger's shortages.

Table 5B.8-5.
Water Management Strategies Considered for the City of Ranger

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Extend contracts w/Eastland Co. WSD	500	$325,000/yr	$650[2]
No Action	-	$19,524,000[3]	$42,443[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Estimated wholesale rate for treated water.
[3] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2050 as estimated by TWDB.

5B.8.4.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Ranger:

- Extend existing contract with Eastland Co. WSD to supply an additional 521 acft/yr

5B.8.4.4 Costs

Costs of the Recommended Plan for the City of Ranger to meet 2030 shortages are:

a. Extension of contract with Eastland Co. WSD:
   - Cost Source: Estimated wholesale of $650/acft for treated water
   - Date to be Implemented: 2032
   - Total Annual Cost: $325,000

5B.8.5 City of Rising Star

5B.8.5.1 Description of Supply

The City of Rising Star uses locally available groundwater for all of its water supply and no current or future shortage is projected. Therefore, no changes in the water supply system are recommended.

5B.8.6 County-Other Category

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.8.7 Manufacturing

The water supply entities for Manufacturing show a projected surplus and no changes in water supply are recommended.

5B.8.8 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.8.9 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.8.10 Irrigation

5B.8.10.1 Description of Supply

Surface water supplies for Eastland County Irrigation are obtained from Lake Leon, the Leon River, and its tributaries. The estimated reliable supply of surface water for Irrigation is 806 feet until 2050. The groundwater supplies in the county are obtained from the Trinity Aquifer. The estimated reliable supply of groundwater is 4,411 acft until 2050. As demonstrated in Table 5B.8-1, a current and long-term shortage in Irrigation water supplies exists through the year 2050.

5B.8.10.2 Options Considered

Table 5B.8-6 lists the water management strategies that were considered for Eastland County Irrigation shortages, and references the report section discussing the strategy, total project cost, and unit costs for meeting the shortage.

Table 5B.8-6.
Water Management Strategies Considered for Eastland County Irrigation

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Irrigation System Conversion [1]	1,495	$177,905/yr	$119
Irrigation Scheduling [1]	650	$3,250/yr	$50
Brush Control	(*)	(*)	(*)
Weather Modification [2]	(*)	$500,000 to $850,000/yr	(*)
No Action	-	$1,072,000[3]	$144[3]

[1] Source of Cost Estimate: Texas Agriculture Experiment Station.
[2] Source of Cost Estimate: Section 5B.10.
[3] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.
* Definitive yield and/or cost cannot be determined.

5B.8.10.3 Water Supply Plan

No new water supplies are economically feasible to meet the projected shortage. Water conservation strategies in the form of conversion to irrigation systems with increased efficiency could partially meet the unmet demands. The irrigation systems in Eastland County are relatively efficient. Options are upgrade of side roll systems to center pivots and possibly some renozzling of older center pivots, and irrigation scheduling. Cultural practices such as crop selection, deficit irrigation, and conversion to dryland will account for the remainder of the water conserved (i.e., water not used).

As shown on Table 5B.8-7, conservation practices can meet about 2,145 acft/yr of the projected shortage.

5B.8.10.4 Costs

Costs of the Recommended Plan for irrigation supply are outlined in Table 5B.8-7. Costs for some options, such as brush control and weather modification, can not be directly quantified due to lack of specific data. Costs have been estimated based on generally available data outlined in the corresponding chapter in Section 5B. For irrigation conversion, an estimated 6,500 acres of the total irrigated acreage would be upgraded to conserve 0.23 acft water per acre of irrigated land, at an average annual cost of $119.18/acre foot. This would provide 1,495 acft annually. Irrigation scheduling with scientific methods could save an additional 10 percent of the irrigation water applied (0.1 acft/acre) at an annual cost of $5/acre for 6,500 acres.

Table 5B.8-7.
Recommended Plan Costs by Decade for Eastland County Irrigation[1]

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Irrigation System Conversion[2]						
Projected Shortage (acft/yr)[3]	(7,363)	(7,385)	(7,404)	(7,423)	(7,437)	(7,443)
Supply from Plan Element (acft/yr)	1,495	1,495	1,495	1,495	1,495	1,495
Annual Cost ($/yr)	$177,905	$177,905	$177,905	$177,905	$177,905	$177,905
Unit Cost ($/acft)	$119	$119	$119	$119	$119	$119
Irrigation Scheduling[2]						
Supply from Plan Element (acft/yr)	650	650	650	650	650	650
Annual Cost ($/yr)	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
Unit Cost ($/acft)	$50	$50	$50	$50	$50	$50
Brush Control						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Weather Modification[4]						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Sum of Supply from Plan Elements (acft/yr)	(2,145)	(2,145)	(2,145)	(2,145)	(2,145)	(2,145)
Unmet Demand (acft/yr)[5]	(5,218)	(5,240)	(5,259)	(5,278)	(5,292)	(5,298)

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for water conserved through management practices.
2 Source of Cost Estimate: Texas Agriculture Experiment Station.
3 Total projected irrigation shortages are presented.
4 Source of Cost Estimate: Section 5B.10.
5 Apart from the conservation options presented, it is not economically feasible to meet projected irrigation shortage in Eastland County.
* Definitive yield and/or cost cannot be determined.

5B.8.11 Livestock

Livestock water use category shows a projected surplus and no changes in water supply are recommended.

5B.9 Erath County Water Supply Plan

Table 5B.9-1 lists each water user group in Erath County and their corresponding surplus or shortage in years 2030 and 2050.

Table 5B.9-1.
Erath County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Dublin	0	0	No projected needs
City of Stephenville	(1,538)	(1,899)	Projected shortage – see plan below
County-Other	69	29	Projected surplus
Manufacturing	58	30	Projected surplus
Steam-Electric	0	0	No projected needs
Mining	0	0	No projected needs
Irrigation	4,128	4,394	Projected surplus
Livestock	6,073	6,073	Projected surplus

[1] From Tables 4-17 and 4-18, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.9.1 The City of Dublin

The City of Dublin obtains its water supply from the Upper Leon Municipal Water District (Upper Leon MWD). The Upper Leon MWD has contracted for surface water from Lake Proctor and treats and delivers it to the City of Dublin. The City of Dublin and Upper Leon MWD have contracted for adequate quantities of water to provide a firm supply and meet their needs through the year 2050.

5B.9.2 City of Stephenville

5B.9.2.1 Description of Supply

The City of Stephenville obtains its water supply from groundwater from the Trinity Aquifer. The City's water supply is currently limited by the capacity of existing infrastructure (i.e., well capacity) to meet projected demands. The City has been planning to increase its water supply and two primary options have been considered. These options include installation of additional wells and pipelines to increase the groundwater production capacity and implementation of a new surface water supply system from Lake Proctor through the purchase of treated water from the Upper Leon MWD. The City has contracted with the Brazos River Authority for 2,714 acft/yr from Lake Proctor.

5B.9.2.2 Options Considered

Table 5B.9-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Stephenville's shortage.

Table 5B.9-2.
Water Management Strategies Considered for the City of Stephenville

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	209	$120,000/yr	$574[2]
Lake Proctor – Upper Leon MWD	2,714	$10,178,000	$551[3]
Additional Groundwater Development – Trinity Aquifer	2,714	$13,766,000	$455[3]
No Action	-	-[4]	-[4]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Water Supply Study for City of Stephenville (Jan., 2000) adjusted for SB1 debt service computations.
4 Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.9.2.3 Water Supply Plan

The City of Stephenville has evaluated alternatives of developing a surface water supply from Lake Proctor to supplement their existing groundwater supply and additional development of the Trinity Aquifer. A study completed in January 2000 demonstrated that the costs for each alternative are approximately equal over the study period. The surface water option provides a means for Stephenville to diversify its water supply. Based on the results of the January, 2000 study and working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage of the City of Stephenville:

- Lake Proctor – Upper Leon MWD

5B.9.2.4 Costs

Costs of the recommended plan for the City of Stephenville to meet 2030 shortages are:

a. Lake Proctor – Upper Leon MWD:
   - Cost Source: City of Stephenville Water Supply Study (January, 2000)
   - Date to be Implemented: before 2010
   - Total Project Cost: $10,178,000

Table 5B.9-3.
Recommended Plan Costs by Decade for the City of Stephenville

Plan Element	2000	2010	2020	2030	2040	2050
Lake Proctor – Upper Leon MWD						
Projected Surplus/(Shortage) (acft/yr)	(598)	(930)	(1,237)	(1,538)	(1,750)	(1,899)
Supply from Plan Element (acft/yr)	-	2,714	2,714	2,714	2,714	2,714
Annual Cost ($/yr)	-	$1,301,000	$1,444,000	$1,584,000	$944,000	$1,013,000
Unit Cost ($/acft)	-	$1,399	$1,167	$1,030	$539	$534

5B.9.3 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.9.4 Manufacturing

Manufacturing is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.9.5 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.9.6 Mining

No Mining demand exists or is projected for the county.

5B.9.7 Irrigation

Irrigation is projected to have a surplus of water from available groundwater and surface water supplies and no changes in water supply are recommended.

5B.9.8 Livestock

No shortages are projected for Livestock use and no changes in water supply are recommended.

5B.10 Falls County Water Supply Plan

Table 5B.10-1 lists each water user group in Falls County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.10-1.
Falls County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Lott	95	107	Projected surplus
City of Marlin	2,975	2,853	Projected surplus-see plan below
City of Rosebud	356	342	Projected surplus
County-Other	3,246	3,153	Projected surplus
Manufacturing	920	920	Projected surplus
Steam-Electric	0	0	No Projected Needs
Mining	705	707	Projected surplus
Irrigation	18,526	18,883	Projected surplus
Livestock	0	0	No Projected Needs

[1] From Tables 4-19 and 4-20, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.10.1 City of Lott

The City of Lott obtains its water supply from the Central Texas Water Supply Corporation, which treats and delivers water from Lake Stillhouse Hollow. The City of Lott has contracted with Central Texas WSC for 184 acft/yr of supply which exceeds its 2050 water supply demand of 77 acft/yr. No change in water supply is recommended.

5B.10.2 City of Marlin

5B.10.2.2 Description of Supply

The City of Marlin obtains its water supply from surface water from local reservoirs and the Brazos River. The City owns and operates two existing reservoirs, Marlin City Lake and New Marlin Reservoir, that impound runoff from Big Sandy Creek. The City also owns water rights that authorize diversion of 4,000 acft/yr from the Brazos River and have contracted with the Brazos River Authority for 1,200 acft/yr from the BRA system. Currently, the City utilizes surface water from the two existing reservoirs as its primary supply and diverts water from Brazos River only in an emergency, to supplement the supply in the two existing reservoirs.

5B.10.2.2 Water Supply Plan

In order to develop additional surface water supply and decrease the need for water from the Brazos River, the City of Marlin, Falls County, and the Natural Resource Conservation Service have been actively pursuing the implementation of a new reservoir, Brushy Creek Reservoir. The Brushy Creek Reservoir is part of the Big Creek Watershed Project. Brushy Creek Reservoir is proposed as a multi-purpose reservoir for water supply, flood control, and recreation. Water rights been granted and the project is currently in the land acquisition stage.

5B.10.2.3 Costs

- Cost Source: NRCS Reservoir Cost Estimate for Big Creek Watershed Project.
- Date to be Implemented: By Year 2005.
- Total Project Cost: $5,834,824 (Brushy Creek Reservoir only).

Cost for this reservoir was developed by the NRCS in 1994 dollars. The cost was updated to 1999 dollars using the ENR CCI price index. Dam and reservoir operation and maintenance was estimated as 1.5 percent of the total reservoir project cost.

Table 5B.10-2.
Recommended Plan Costs by Decade for the City of Marlin

Plan Element	2000	2010	2020	2030	2040	2050
Brushy Creek Reservoir						
Projected Shortage (acft/yr)	0	0	0	0	0	0
Supply From Plan Element (acft/yr)	-	2,000	2,000	2,000	2,000	2,000
Annual Cost ($/yr)	-	$475,314	$475,314	$475,314	$475,314	$87,522
Unit Cost ($/acft)	-	$238	$238	$238	$238	$44

5B.10.3 City of Rosebud

The City of Rosebud obtains its water supply from the Central Texas Water Supply Corporation, which treats and delivers water from Lake Belton. The City of Rosebud has contracted with Central Texas WSC for 600 acft/yr of supply which exceeds its 2050 water supply demand of 258 acft/yr. No change in water supply is recommended.

5B.10.4 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.10.5 Manufacturing

Manufacturing is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.10.6 Steam-Electric

No Steam-Electric demand exists nor is projected for the county.

5B.10.7 Mining

Mining is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.10.8 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended. Additional supply may be available for Irrigation use through implementation of the Big Creek Watershed Project.

5B.10.9 Livestock

Livestock is projected to have a no additional need for water through the year 2050 and no changes in water supply are recommended. Additional supply may be available for Livestock use through implementation of the Big Creek Watershed Project.

5B.11 Fisher County Water Supply Plan

Table 5B.11-1 lists each water user group in Fisher County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Fisher County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plan described below either includes specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.11-1.
Fisher County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Roby	(54)	(48)	Projected shortage – see plan below
City of Rotan	0	0	Supply allocated based on projected demand
County-Other	69	89	Projected surplus
Manufacturing	65	32	Projected surplus
Steam-Electric	0	0	No demand or supply
Mining	100	96	Projected surplus
Irrigation	3,991	4,126	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-21 and 4-22, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.11.1 City of Roby

5B.11.1.1 Description of Supply

Surface water supplies are obtained from the City of Sweetwater. The City of Roby surface water supply is limited due to an expiring contract with the City of Sweetwater in 2023.

5B.11.1.2 Options Considered

Table 5B.11-2 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Roby's shortages.

Table 5B.11-2.
Water Management Strategies Considered for the City of Roby

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Seymour Aquifer development - Fisher Co.	([1])	([1])	([1])
Seymour Aquifer Storage and Recovery Project (Section 5A.12)	11,100	$31,895,000[2]	$278
Voluntary Redistribution from Colorado River MWD	54	$52,650/yr	$975[3]
Extend existing contracts	54	$35,100/yr	$650[3]
No Action	-	$2,292,000[4]	$42,443[4]

[1] Potential option that may need further study.
[2] Cost does not include transmission to the City of Roby.
[3] Estimated wholesale rate for treated water.
[4] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.11.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Roby:

- Extension of existing contracts with City of Sweetwater

5B.11.1.4 Costs

Costs of the Recommended Plan for the City of Roby.

Extension of existing contracts with City of Sweetwater:

- Cost Source: Estimated wholesale of $650/acft for treated water
- Date to be Implemented: 2023 (when contract expires)
- Total Annual Cost: $35,100

If a contract with City of Sweetwater cannot be negotiated, then City of Roby will need to consider their other supply options, including purchase of water from Colorado River MWD (if any is available), Seymour Aquifer groundwater, or Seymour Aquifer Storage and Recovery (ASR). The Seymour ASR is a possible joint project with City of Anson.

5B.11.2 City of Rotan

The City of Rotan is currently purchasing water under contract from the City of Snyder. However, contract terms are not available and supply is allocated based on projected demands.

5B.11.3 County-Other

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.11.4 Manufacturing

The water supply entities for Manufacturing show a projected surplus and no changes in water supply are recommended.

5B.11.5 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.11.6 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.11.7 Irrigation

No shortages are projected for Fisher County Irrigation and no changes in water supply are recommended.

5B.11.8 Livestock

No shortages are projected for Fisher County Livestock and no changes in water supply are recommended.

5B.12 Grimes County Water Supply Plan

Table 5B.12-1 lists each water user group in Grimes County and their corresponding surplus or shortage in years 2030 and 2050.

Table 5B.12-1.
Grimes County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)1		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Anderson	38	47	Projected Surplus
City of Navasota	585	543	Projected Surplus
County-Other	10,011	9,840	Projected Surplus
Manufacturing	949	857	Projected Surplus
Steam-ElectricElectric	0	0	No Shortage/No Surplus
Mining	57	64	Projected Surplus
Irrigation	2,035	2,035	Projected Surplus
Livestock	1,673	1,673	Projected Surplus

[1] From Tables 4-23 and 4-24, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.12.1 City of Anderson

The City of Anderson obtains its water supply from Anderson Water Supply, Inc. Anderson Water Supply, Inc. produces groundwater from the Carrizo-Wilcox Aquifer near the City of Anderson and delivers treated water to the City. The existing production capacity of the wells and groundwater availability is adequate to supply the needs of the City of Anderson through the year 2050. No change in water supply is recommended.

5B.12.2 City of Navasota

The City of Navasota obtains its water supply from groundwater from the Carrizo-Wilcox Aquifer. The existing production capacity of the wells and groundwater availability is adequate to supply the needs of the City of Navasota through the year 2050. No change in water supply is recommended.

5B.12.3 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.12.4 Manufacturing

Manufacturing is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.12.5 Steam-Electric

Steam-Electric is projected to have a surplus of water through the year 2050. Steam-electric demand in Grimes County is associated with the Gibbons Creek Power Plant, owned and operated by the Texas Municipal Power Agency (TMPA), and the proposed Tenaska Frontier Generation Station by Tenaska, Inc. The Gibbons Creek Power Plant is supplied by Gibbons Creek Reservoir that impounds runoff from Gibbons Creek and from diversions authorized from the Navasota River. The TMPA also has contracted for water from the Brazos River Authority from Lake Limestone to meet the projected needs through the year 2050. The future Tenaska Frontier Generation Station's water supply is proposed to be from a contract with the City of Huntsville (Region H). No changes in water supply are recommended.

5B.12.6 Mining

Mining is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.12.7 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.12.8 Livestock

Livestock is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.13 Hamilton County Water Supply Plan

Table 5B.13-1 lists each water user group in Hamilton County and their corresponding surplus or shortage in years 2030 and 2050.

Table 5B.13-1.
Hamilton County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Hamilton	1,544	1,600	Projected surplus; possible regional provider – see plan below
City of Hico	138	161	Projected surplus
County-Other	322	357	Projected surplus
Manufacturing	2	2	Projected surplus
Steam-Electric	0	0	No projected needs
Mining	0	0	No projected needs
Irrigation	672	776	Projected surplus
Livestock	0	0	No projected needs

[1] From Tables 4-25 and 4-26, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.13.1 City of Hamilton

The City of Hamilton obtains its water supply from Lake Proctor through the Upper Leon Municipal Water District with a contract for 2,000 acft/yr of supply. The City of Hamilton sells a portion of its supply to Multi-County WSC. The City's available supply exceeds the 2050 demands. No change in water supply is recommended.

5B.13.2 City of Hico

The City of Hico obtains its water supply from groundwater from the Trinity Aquifer. The existing production capacity of the wells and groundwater availability is adequate to supply the needs of the City of Hico through the year 2050. No change in water supply is recommended.

5B.13.3 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.13.4 Manufacturing

No Manufacturing demand exists or is projected for the county.

5B.13.5 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.13.6 Mining

No Mining demand exists or is projected for the county.

5B.13.7 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.13.8 Livestock

Livestock water supply is projected to meet demands through the year 2050 and no changes in water supply are recommended.

5B.14 Haskell County Water Supply Plan

Table 5B.14-1 lists each water user group in Haskell County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Haskell County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plan described below either includes specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.14-1.
Haskell County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Haskell	(526)	(538)	Projected shortage – see plan below
City of Rule	4	3	Projected surplus
City of Stamford[P]	0	0	Supply equals demand
County-Other	2,412	1,974	Projected surplus
Manufacturing	0	0	No demand or supply
Steam-Electric	(1,709)	(1,825)	Projected shortage – see plan below
Mining	86	97	Projected surplus
Irrigation	2,652	3,811	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-27 and 4-28, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.
[P] Indicates city is in multiple counties. Projections shown are for Haskell County portion only.

5B.14.1 The City of Haskell

5B.14.1.1 Description of Supply

Surface water supplies are obtained from local sources and Lake Millers Creek. The City of Haskell surface water supply is limited due to an expiring contract with North Central Texas MWD in 2010.

5B.14.1.2 Options Considered

Table 5B.14-2 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Haskell's shortages.

Table 5B.14-2.
Water Management Strategies Considered for the City of Haskell

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Extend existing contracts	504	$327,600/yr	$650[2]
Wastewater Reuse (Section 5A.3)	107	$432,124	$326
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629[3]
Seymour Aquifer Development in Jones County (Section 5A.12)	11,100	$31,895,000	$278
No Action	-	$22,325,000[4]	$42,443[4]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
2 Estimated wholesale rate for treated water.
3 Raw water cost in the reservoir.
4 Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.14.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Haskell:

- Extend existing contract, if possible, to supply an additional 504 acft/yr
- Wastewater Reuse to supply at least an additional 22 acft/yr

For the long-term period beyond 2030, the following strategies are recommended for consideration:

- Voluntary Redistribution from Stamford

The Breckenridge Reservoir has been recommended for the long-term needs of the West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.14.1.4 Costs

Costs of the Recommended Plan for the City of Haskell.

a. Extension of existing contract:
   - Cost Source: Estimated wholesale rate of $650/acft for treated water
   - Date to be Implemented: before 2010
   - Total Annual Cost: $327,600

b. Wastewater Reuse
   - Cost Source: Section 5A.3
   - Date to be Implemented: before 2010
   - Total Project Cost: $432,000

Table 5B.14-3.
Recommended Plan Costs by Decade for City of Haskell

	2000	*2010*	*2020*	*2030*	*2040*	*2050*
Projected Surplus/(Shortage) (acft/yr)	(45)	(31)	(527)	(526)	(525)	(538)
Extension of Existing Contract						
Supply from Plan Elements (acft/yr)	0	504	504	504	504	504
Annual Costs ($/yr)	0	$327,600	$327,600	$327,600	$327,600	$327,600
Unit costs ($/acft)	0	$650	$650	$650	$650	$650
Wastewater Reuse						
Supply from Plan Element (acft/yr)	0	107	107	107	107	107
Annual Cost ($/yr)	$0	$35,000	$35,000	$35,000	$3,500	$3,500
Unit Cost ($/acft)	$0	$326	$326	$326	$32	$32
Total New Supply (acft/yr)	0	611	611	611	611	611

5B.14.2 The City of Rule

5B.14.2.1 Description of Supply

The City of Rule uses surface water from local sources and Lake Millers Creek. However, the surface water supply is limited due to an expiring contract with North Central

Texas MWD in 2019. The city also uses groundwater from the Seymour Aquifer. No shortages are projected.

5B.14.2.2 Options Considered

Table 5B.14-4 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Rule's shortages.

Table 5B.14-4.
Water Management Strategies Considered for the City of Rule

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Extend existing contracts	30	$19,500/yr	$650[2]
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Estimated wholesale rate for treated water.
[3] Raw water cost in the reservoir.
[4] Economic Impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.14.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Rule:

- Extend existing contract, if possible, to supply an additional 30 acft/yr

The Breckenridge Reservoir has been recommended for the long-term needs of West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.14.2.4 Costs

Costs of the Recommended Plan for the City of Rule.

a. Extension of existing contract:
   - Cost Source: Estimated wholesale of $650/acft for treated water

- Date to be Implemented: 2010
- Total Annual Cost: $19,500

5B.14.3 The City of Stamford

The City of Stamford is primarily in Jones County and its proposed plan is described in Section 5B.18.

5B.14.4 County-Other Category

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.14.5 Manufacturing

No Manufacturing demand exists or is projected for the county.

5B.14.6 Steam-Electric

5B.14.6.1 Description of Supply

Steam-Electric water supply is obtained from Lake Stamford to provide cooling for the West Texas Utilities plant.

5B.14.6.2 Options Considered

Table 5B.14-5 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the Steam-Electric sector's shortages.

Table 5B.14-5.
Water Management Strategies Considered for Haskell County Steam-Electric

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
California Creek diversion (raw water) (Section 5A.7.2)	3,750	$6,300,000	$171
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629
No Action	-	$8,035,000[1]	$4,701[1]

[1] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.14.6.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Steam-Electric sector:

- California Creek diversion to supply an additional 1,875 acft/yr, which is half of the yield increase and the other half is allocated to Stamford municipal supply.

The Breckenridge Reservoir has been recommended for the long-term needs of the West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.14.6.4 Costs

Costs of the Recommended Plan for the Steam-Electric sector.

a. California Creek diversion:
   - Cost Source: Section 5A.7.2
   - Date to be Implemented: 2001
   - Total Project Cost: $6,300,000
   - Total Annual Cost: $171/acft

Table 5B.14-6.
Recommended Plan Costs by Decade for Steam-Electric

Plan Element	2000	2010	2020	2030	2040	2050
Projected Shortage (acft/yr)	0	(933)	(1651)	(1709)	(1767)	(1825)
Supply from Plan Elements (acft/yr)	0	1,875	1,875	1,875	1,875	1,875
Annual Cost ($/yr)	0	$320,000	$320,000	$320,000	$320,000	$320,000
Unit Cost ($/acft)[1]	0	$171	$171	$171	$35	$35

[1] Unit cost is for full utilization of capacity. Operation and maintenance of existing facilities is not included.

5B.14.7 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.14.8 Irrigation

No shortages are projected for Haskell County Irrigation and no changes in water supply are recommended.

5B.14.9 Livestock

No shortages are projected for Haskell County Livestock and no changes in water supply are recommended.

5B.15 Hill County Water Supply Plan

Table 5B.15-1 lists each water user group in Hill County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.15-1.
Hill County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Hillsboro	638	497	Projected surplus
City of Hubbard	0	0	No projected needs
City of Itasca	98	87	Projected surplus
City of Whitney	447	442	Projected surplus
County-Other	818	316	Projected surplus
Manufacturing	(56)	(84)	Projected shortage – see plan below
Steam-Electric	0	0	No projected needs
Mining	33	5	Projected surplus
Irrigation	1,290	1,293	Projected surplus
Livestock	0	0	No projected needs

[1] From Tables 4-29 and 4-30, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.15.1 City of Hillsboro

The City of Hillsboro obtains its water supply from the Aquilla Water Supply District (Aquilla WSD). Aquilla WSD has contracted with the Brazos River Authority for surface water from Lake Aquilla and diverts, treats, and delivers water to the City of Hillsboro. The existing facilities are adequate to supply the needs of the City of Hillsboro through the year 2050. No change in water supply is recommended.

5B.15.2 City of Hubbard

The City of Hubbard obtains its water supply from surface water from Lake Navarro Mills through the Post Oak Special Utility District (SUD). The Post Oak SUD purchases treated water from the City of Corsicana and delivers it to the City of Hubbard. The existing contractual arrangements and conveyance capacity of the system are adequate to meet the needs of the City of Hubbard through the year 2050. No change in water supply is recommended.

5B.15.3 City of Itasca

The City of Itasca obtains its water supply from groundwater from the Trinity and Woodbine Aquifers. The existing production capacity of the wells and groundwater availability are adequate to supply the needs of the City of Itasca through the year 2050. No change in water supply is recommended.

5B.15.4 City of Whitney

The City of Whitney obtains its water supply from groundwater from the Trinity Aquifer. The City of Whitney has also contracted with the Brazos River Authority for 750 acft of surface water supply from Lake Whitney, however, the City has not implemented the required infrastructure to utilize this supply. The production capacity of the City's existing wells and groundwater availability are adequate to supply the needs of the City of Whitney through the year 2050. No change in water supply is recommended.

5B.15.5 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.15.6 Manufacturing

Water supply for Manufacturing in Hill County is obtained by purchase from a city or water supply corporation or from private wells operated by the manufacturing entity. Each of the cities and the rural area outside of the cities in Hill County have surplus supplies through the year 2050. New manufacturing facilities would be expected to locate where existing water supplies are available, such as near a City or within the service area of an existing water supply corporation. Any of the cities or County-Other in Hill County would have the available water supply to meet all of the projected Manufacturing shortage.

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage for Manufacturing Use in Hill County:

- Voluntary Redistribution from Municipal Use

Costs

Costs of the recommended plan for Manufacturing Use in Hill County to meet 2050 shortages are:

a. Voluntary Redistribution from Municipal Use:
- Cost Source: Estimate of wholesale cost of water
- Date to be Implemented: By Year 2010
- Annual Cost: $54,600 per year

The Annual Cost of $54,600 is based upon multiplying the desired amount of water, 84 acft, by the estimated water rate of $650 per acft.

5B.15.7 Steam-Electric

No Steam-Electric demand exists nor is projected for the county.

5B.15.8 Mining

Mining is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.15.9 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.15.10 Livestock

Livestock water supply is projected to meet demands through the year 2050 and no changes in water supply are recommended.

5B.16 Hood County Water Supply Plan

Table 5B.16-1 lists each water user group in Hood County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.16-1.
Hood County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)1		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Granbury	(2,905)	(3,835)	Projected shortage – see plan below
City of Tolar	25	28	Projected surplus
County-Other	1,486	789	Projected surplus
Manufacturing	7	0	Projected surplus
Steam-Electric	33,300	33,205	Projected surplus
Mining	33	31	Projected surplus
Irrigation	1,639	1,868	Projected surplus
Livestock	0	0	

[1] From Tables 4-31 and 4-32, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.16.1 City of Granbury

5B.16.1.1 Description of Supply

The City of Granbury obtains its water supply from groundwater from the Trinity Aquifer and from surface water from Lake Granbury. The city owns and operates 13 wells that produce water from the Trinity Aquifer that currently serves as the primary water supply. The City has contracted for 13,800 acft/yr from the Brazos River Authority for water from Lake Granbury. Due to the water quality in Lake Granbury, desalination treatment is required. The City owns a small desalination treatment plant that it operates only during the summer months, if needed, to meet peak demands. The City has also contracted with the Brazos River Authority for 0.72 MGD (806 acft/yr) of treatment capacity from the Surface Water and Treatment System (SWATS) located at Lake Granbury. The City has contracted with Acton Municipal Utility

District to deliver the treated water from SWATS to the City through Acton MUD's system. The City is also currently in the process of implementing their own transmission facilities from the SWATS water treatment plant.

The raw water supply of 13,800 acft/yr that the City of Granbury has contracted for with the Brazos River Authority provides a surplus of 9,433 acft/yr in the year 2030 for the city, not including the existing groundwater supply currently in use. However, the water supply available to the City is constrained by the infrastructure capacity including the ability to divert and treat water from Lake Granbury. The infrastructure capacity limitation results in a water supply shortage for the City of Granbury in the year 2030 and 2050.

5B.16.1.2 Options Considered

The City of Granbury has a shortage of 2,905 acft per year in 2030, which is about 67 percent of demand. Table 5B.16-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Granbury shortage.

Table 5B.16-2.
Water Management Strategies Considered for the City of Granbury

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation	530	$304,000	574[2]
Lake Granbury SWATS Expansion – 2030	2,905	$18,651,000[3]	778[3]
No Action	-	$126,810,000*	$43,652*

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.11 (prorated for City of Granbury).
* Economic Impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.16.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Granbury:

- Lake Granbury SWATS Expansion

For the long-term period beyond 2030, the following additional water management strategy is recommended:

- Lake Granbury SWATS Expansion

5B.16.1.4 Costs

Costs of the Recommended Plan for the City of Granbury.

a. Item 1:
   - Cost Source: Table 5A.11-8
   - Date to be Implemented: before 2010
   - Total Project Cost: $18,651,000 (prorated for City of Granbury)
   - Annual Cost: $2,260,000

Table 5B.16-3.
Recommended Plan Costs by Decade for the City of Granbury

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Lake Granbury SWATS Expansion						
Projected Surplus/(Shortage) (acft/yr)	73	(1,025)	(2,503)	(2,905)	(3,348)	(3,835)
Supply From Plan Element (acft/yr)	-	2,905	2,905	2,905	2,905	2,905
Annual Cost ($/yr)	-	$2,260,000	$2,260,000	$2,260,000	$1,610,000	$1,610,000
Unit Cost ($/acft)	-	$778	$778	$778	$420	$420

5B.16.2 City of Tolar

The City of Tolar obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates five wells that are projected to supply the needs of the City of Tolar through the year 2050. No shortages are projected for the City of Tolar and no changes in water supply are recommended.

5B.16.3 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.16.4 Manufacturing

Manufacturing is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.16.5 Steam-Electric

Steam-Electric water demand in Hood County is associated with the DeCordova Power Plant owned and operated by Texas Utilities Company (TXU). The DeCordova Power Plant is supplied by water from Lake Granbury. TXU has contracted with the Brazos River Authority for water from the BRA system in sufficient quantity to exceed its needs through the year 2050. No changes in water supply are recommended.

5B.16.6 Mining

Mining is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.16.7 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.16.8 Livestock

No shortages are projected for Livestock use and no changes in water supply are recommended.

5B.17 Johnson County Water Supply Plan

Table 5B.17-1 lists each water user group in Johnson County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.17-1.
Johnson County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Alvarado	(72)	(220)	Projected shortage – see plan below
City of Briar Oaks	(36)	(38)	Projected shortage – see plan below
City of Burleson	(783)	(1,544)	Projected shortage – see plan below
City of Cleburne	1,716	(2,822)	Projected shortage – see plan below
City of Godley	(60)	(60)	Projected shortage – see plan below
City of Grandview	(160)	(190)	Projected shortage – see plan below
City of Joshua	(29)	(209)	Projected shortage – see plan below
City of Keene	(1,149)	(1,495)	Projected shortage – see plan below
City of Mansfield	172	262	Projected surplus
City of Rio Vista	(34)	(36)	Projected shortage – see plan below
City of Venus	(323)	(418)	Projected shortage – see plan below
County-Other	(7,054)	(9,046)	Projected shortage – see plan below
Manufacturing	(1,309)	(1,839)	Projected shortage – see plan below
Steam-Electric	0	0	Supply equals demand
Mining	(33)	(21)	Projected shortage – see plan below
Irrigation	247	247	Projected surplus
Livestock	2,582	2,582	Projected surplus

[1] From Tables 4-33 and 4-34, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.17.1 City of Alvarado

5B.17.1.1 Description of Supply

The City of Alvarado obtains its water supply from groundwater from the Trinity Aquifer and from surface water from Lake Alvarado. The City owns and operates six wells that serve as the city's current primary supply. Lake Alvarado is owned by the City of Alvarado, however, the city has not implemented a water treatment plant to utilize this source. The City also has contracted for a small amount (11 acft/yr) of water from Johnson County Rural WSC, however, this contract expires in the year 2001. Based on the city's existing water supply, a shortage is projected in the amount of 72 acft/yr in the year 2030 and 220 acft/yr in the year 2050.

5B.17.1.2 Options Considered

Table 5B.17-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Alvarado's shortage.

Table 5B.17-2.
Water Management Strategies Considered for the City of Alvarado

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	35	$20,000/yr	$574[2]
Voluntary Redistribution (Section 5A.6)	220	$5,000/yr	$23[3]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	72	$690,000	$1,180[4]
Lake Granbury SWATS Expansion (2050) (Section 5A.16)	148	$1,418,000	$1,180[4]
No Action	-	$3,340,000[5]	$46,394[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.6.
[4] Source of Cost Estimate: Section 5A.16 (prorated for City of Alvarado), Includes cost of raw water supply.
[5] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Alvarado:

- Lake Granbury SWATS expansion by 2030 to supply an additional 72 acft/yr
- Voluntary Redistribution from BRA System

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Lake Granbury SWATS Expansion

5B.17.1.4 Costs

Costs of the recommended plan for the City of Alvarado to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
  - Cost Source: Section 5A.16
  - Date to be Implemented: before 2010
  - Total Project Cost: $690,000
  - Annual Cost: $85,000

Table 5B.17-3.
Recommended Plan Costs by Decade for the City of Alvarado

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Lake Granbury SWATS Expansion						
Projected Surplus/(Shortage) (acft/yr)	205	105	(7)	(72)	(142)	(220)
Supply from Plan Element (acft/yr)	-	72	72	72	220	220
Annual Cost ($/yr)	-	$85,000	$85,000	$85,000	$190,000	$190,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$863	$863

5B.17.2 City of Briar Oaks

5B.17.2.1 Description of Supply

The City of Briar Oaks obtains its water supply from groundwater from the Trinity Aquifer. Based on the supply available from the Trinity Aquifer, the City of Briar Oaks is projected to have a shortage in the amount of 36 acft/yr in the year 2030 and 38 acft/yr in the year 2050.

5B.17.2.2 Options Considered

Table 5B.17-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Briar Oaks' projected shortage.

Table 5B.17-4.
Water Management Strategies Considered for the City of Briar Oaks

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	3	$1,700/yr	$574[2]
Voluntary Redistribution (Section 5A.6)	41	$940/yr	$23[3]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	41	$393,000	$1,180[4]
No Action	-	$1,528,000[5]	$42,443[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.6.
[4] Source of Cost Estimate: Section 5A.16 (prorated for City of Briar Oaks). Includes cost of raw water supply.
[5] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB

5B.17.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage of the City of Briar Oaks:

- Lake Granbury SWATS expansion by 2030 to supply an additional 36 acft/yr
- Voluntary Redistribution from BRA System

5B.17.2.4 Costs

Costs of the recommended plan for the City of Briar Oaks to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
   - Cost Source: Section 5A.16
   - Date to be Implemented: before 2010
   - Total Project Cost: $393,000
   - Annual Cost: $48,000

Table 5B.17-5.
Recommended Plan Costs by Decade for the City of Briar Oaks

Plan Element	2000	2010	2020	2030	2040	2050
Lake Granbury SWATS Expansion						
Projected Surplus/(Shortage) (acft/yr)	(45)	(41)	(38)	(36)	(37)	(38)
Supply from Plan Elements (acft/yr)	-	41	41	41	41	41
Annual Cost ($/yr)	-	$48,000	$48,000	$48,000	$9,000	$9,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$212	$212

5B.17.3 City of Burleson

5B.17.3.1 Description of Supply

The City of Burleson obtains its water supply from Tarrant Regional Municipal Water District (TRMWD). The city purchases water through the City of Fort Worth supply system. Based on the amount of supply currently available from TRMWD, the City of Burleson is projected to have a shortage of 783 acft/yr in the year 2030 and 1,544 acft/yr in the year 2050.

5B.17.3.2 Options Considered

Table 5B.17-6 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Burleson's shortage.

Table 5B.17-6.
Water Management Strategies Considered for the City of Burleson

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	156	$90,000/yr	$574[2]
Water Supply from Tarrant Regional MWD	783	0	766[3]
No Action	-	$34,180,000[4]	$43,652[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Based on estimated cost for treated water from TRMWD System.
[4] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.3.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Burleson:

- Water Supply from Tarrant Regional MWD

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Water Supply from Tarrant Regional MWD

5B.17.3.4 Costs

Costs of the recommended plan for the City of Burleson to meet 2030 shortages are:

a. Water Supply from Tarrant Regional MWD:
   - Cost Source: Based on estimated cost for treated water from TRMWD.
   - Date to be Implemented: before 2010
   - Total Project Cost: $0
   - Annual Cost: $600,000

Table 5B.17-7.
Recommended Plan Costs by Decade for the City of Burleson

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Water Supply from Tarrant MWD						
Projected Shortage (acft/yr)	43	(309)	(341)	(783)	(1,143)	(1,544)
Supply from Plan Element (acft/yr)	0	309	341	783	1,143	1,544
Annual Cost ($/yr)	$0	$237,000	$261,00	$600,000	$875,000	$1,183,000
Unit Cost ($/acft)	$	$766	$766	$766	$766	$766

5B.17.4 City of Cleburne

The City of Cleburne obtains its water supply from Lake Pat Cleburne, Lake Aquilla, and groundwater from the Trinity Aquifer. The city owns and operates Lake Pat Cleburne that impounds runoff from Nolan Creek for storage and use. The city has contracted with the Brazos River Authority for water supply from Lake Aquilla (5,300 acft/yr) and from the BRA System (4,700 acft/yr). Currently, the City of Cleburne has not implemented facilities to utilize the

4,700 acft/yr of water supply from the BRA system. The city owns and operates six wells that produce water from the Trinity Aquifer. Based on the existing water supply available to the City of Cleburne, no shortages are projected through the year 2030 and no changes in water supply are recommended.

5B.17.5 City of Godley

5B.17.5.1 Description of Supply

The City of Godley obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates six wells that serve as its primary supply. The City also has interconnected their system with the Johnson County Rural WSC system for emergency use. Based on the available groundwater supply, the City of Godley is projected to have a shortage of 60 acft/yr in the year 2030.

5B.17.5.2 Options Considered

Table 5B.17-8 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Godley's projected shortage.

Table 5B.17-8. Water Management Strategies Considered for the City of Godley

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	4	$2,300/yr	$574[2]
Voluntary Redistribution (Section 5A.6)	63	$1,450/yr	$23[3]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	63	$604,000	$1,180[4]
No Action	-	$2,547,000[5]	$42,443[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.6.
[4] Source of Cost Estimate: Section 5A.16 (prorated for City of Godley). Includes cost of raw water supply.
[5] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.5.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage of the City of Godley:

- Lake Granbury SWATS expansion
- Voluntary Redistribution from BRA System

5B.17.5.4 Costs

Costs of the recommended plan for the City of Godley to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
   - Cost Source: Section 5A.16
   - Date to be Implemented: before 2010
   - Total Project Cost: $604,000
   - Annual Cost: $74,000

Table 5B.17-9.
Recommended Plan Costs by Decade for the City of Godley

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Lake Granbury SWATS Expansion						
Projected Surplus/(Shortage) (acft/yr)	(67)	(63)	(61)	(60)	(59)	(60)
Quantity Available (acft/yr)	-	63	63	63	63	63
Annual Cost ($/yr)	-	$74,000	$74,000	$74,000	$13,000	$13,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$212	$212

5B.17.6 City of Grand View

5B.17.6.1 Description of Supply

The City of Grand View obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates four wells that serve as the sole source supply for the city. Based on the available groundwater supply, the City of Grand View is projected to have a shortage of 160 acft/yr in the year 2030.

5B.17.6.2 Options Considered

Table 5B.17-10 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Grand View's shortage.

Table 5B.17-10.
Water Management Strategies Considered for the City of Grand View

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	11	$6,300/yr	$574[2]
Voluntary Redistribution (Section 5A.6)	190	$4,400/yr	$23[3]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	160	$1,533,000	$1,180[4]
Lake Granbury SWATS Expansion (2050) (Section 5A.16)	30	$288,000	$1,180[4]
No Action	-	$6,791,000[5]	$42,443[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.6.
[4] Source of Cost Estimate: Section 5A.16 (prorated for City of Grand View). Cost of raw water supply included.
[5] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.6.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Grand View:

- Lake Granbury SWATS Expansion
- Voluntary Redistribution from BRA System

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Lake Granbury SWATS Expansion

5B.17.6.4 Costs

Costs of the recommended plan for the City of Grand View to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
- Cost Source: Section 5A.16
- Date to be Implemented: before 2010
- Total Project Cost: $1,533,000
- Annual Cost: $189,000

Table 5B.17-11.
Recommended Plan Costs by Decade for the City of Grand View

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Lake Granbury SWATS Expansion						
Projected Surplus/(Shortage) (acft/yr)	(138)	(143)	(148)	(160)	(172)	(190)
Supply from Plan Elements (acft/yr)	-	160	160	160	190	190
Annual Cost ($/yr)	-	$189,000	$189,000	$189,000	$69,000	$69,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$363	$363

5B.17.7 City of Joshua

5B.17.7.1 Description of Supply

The City of Joshua obtains its water supply from Johnson County Fresh Water Supply District No. 1 (Johnson Co. FWSD No. 1). Johnson Co. FWSD No. 1 utilizes groundwater from the Trinity Aquifer and surface water from Lake Granbury through the existing SWATS. The district has contracted with the Brazos River Authority for 2,665 acft/yr of supply from the BRA System. The district has contracted with the BRA for 605 acft/yr (0.54 mgd) of conveyance and treatment capacity from SWATS. Based on the existing supply available from groundwater and SWATS, a shortage of 29 acft/yr is projected in the year 2030 and 209 acft/yr in the year 2050.

5B.17.7.2 Options Considered

Table 5B.17-12 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Joshua's shortage.

Table 5B.17-12.
Water Management Strategies Considered for the City of Joshua

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
Additional Water Conservation (Section 5A.2)	34	$20,000/yr	$574[2]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	29	$278,000	$1,180[3]
Lake Granbury SWATS Expansion (2050) (Section 5A.16)	180	$1,725,00	$1,180[3]
No Action	-	$1,345,000[4]	$46,394[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.16 (prorated for City of Joshua).
[4] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.7.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Joshua:

- Lake Granbury SWATS Expansion

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Lake Granbury SWATS Expansion

5B.17.7.4 Costs

Costs of the recommended plan for the City of Joshua to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
   - Cost Source: Section 5A.16
   - Date to be Implemented: before 2030
   - Total Project Cost: $278,000
   - Annual Cost: $34,000

Table 5B.17-13.
Recommended Plan Costs by Decade for the City of Joshua

Plan Element	2000	2010	2020	2030	2040	2050
Lake Granbury SWATS Expansion						
Projected Surplus/(Shortage) (acft/yr)	226	142	64	(29)	(101)	(209)
Supply from Plan Elements (acft/yr)	-	-	-	29	209	209
Annual Cost ($/yr)	-	-	-	$34,000	$247,000	$247,000
Unit Cost ($/acft)	-	-	-	$1,180	$1,180	$1,180

5B.17.8 City of Keene

5B.17.8.1 Description of Supply

The City of Keene obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates 11 wells that serve as their sole source water supply. The City of Keene has experienced water supply problems in recent years and is evaluating various options to meet existing and future needs. Based on the available groundwater supply, a shortage of 1,149 acft/yr is projected for the year 2030 and 1,495 acft/yr for the year 2050.

5B.17.8.2 Options Considered

Table 5B.17-14 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Keene's shortage.

Table 5B.17-14.
Water Management Strategies Considered for the City of Keene

Option	Yield (acft/yr)	Approximate Cost[1] Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	65	$37,000/yr	$574[2]
Voluntary Redistribution (Section 5A.6)	1,495	$34,000/yr	23[3]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	1,149	$11,012,000	$1,180[4]
Lake Granbury SWATS Expansion (2050) (Section 5A.16)	346	$3,316,000	$1,180[4]
No Action	-	$53,306,000[5]	$46,394[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.6.
[4] Source of Cost Estimate: Section 5A.16 (prorated for City of Keene). Costs for raw water supply included.
[5] Economic impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.17.8.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Keene:

- Lake Granbury SWATS Expansion.
- Voluntary Redistribution from BRA System

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Lake Granbury SWATS Expansion

5B.17.8.4 Costs

Costs of the recommended plan for the City of Keene to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
    - Cost Source: Section 5A.16
    - Date to be Implemented: before 2010
    - Total Project Cost: $11,012,000
    - Annual Cost: $1,356,000

Table 5B.17-15.
Recommended Plan Costs by Decade for the City of Keene

Plan Element	2000	2010	2020	2030	2040	2050
Lake Granbury SWATS Expansion						
Projected Shortage (acft/yr)	(623)	(791)	(1,004)	(1,149)	(1,312)	(1,495)
Supply from Plan Element (acft/yr)	-	1,149	1,149	1,149	1,495	1,495
Annual Cost ($/yr)	-	$1,356,000	$1,356,000	$1,356,000	$652,000	$652,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$436	$436

5B.17.9 City of Mansfield

The City of Mansfield obtains its water supply from surface water from the Tarrant Regional Municipal Water District (TRMWD). The city has contracted for sufficient quantity of water supply to meet its projected needs through the year 2050. No shortage is projected for the City of Mansfield and no changes in water supply are recommended.

5B.17.10 City of Rio Vista

5B.17.10.1 Description of Supply

The City of Rio Vista obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates two wells that serve as the city's primary water supply. The city has an existing interconnection with Johnson County Rural WSC for emergency use. Based on the available groundwater supply, the City of Rio Vista is projected to have a shortage of 34 acft/yr in the year 2030 and 36 acft/yr in the year 2050.

5B.17.10.2 Options Considered

Table 5B.17-16 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Rio Vista's shortage.

Table 5B.17-16.
Water Management Strategies Considered for the City of Rio Vista

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	11	$6,300/yr	$574[2]
Voluntary Redistribution (Section 5A.6)	41	$940/yr	$23[3]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	41	$393,000	$1,180[4]
No Action	-	$1,443,000[5]	$42,443[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.6.
[4] Source of Cost Estimate: Section 5A.16 (prorated for City of Rio Vista). Costs for raw water supply included.
[5] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.10.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage of the City of Rio Vista:

- Lake Granbury SWATS Expansion
- Voluntary Redistribution from BRA System

5B.17.10.4 Costs

Costs of the recommended plan for the City of Rio Vista to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
    - Cost Source: Section 5A.16
    - Date to be Implemented: before 2010
    - Total Project Cost: $393,000
    - Annual Cost: $48,000

Table 5B.17-17.
Recommended Plan Costs by Decade for the City of Rio Vista

Plan Element	2000	2010	2020	2030	2040	2050
Lake Granbury SWATS Expansion						
Projected Shortage (acft/yr)	(44)	(41)	(37)	(34)	(34)	(36)
Supply from Plan Element (acft/yr)	-	41	41	41	41	41
Annual Cost ($/yr)	-	$48,000	$48,000	$48,000	$8,700	$8,700
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$212	$212

5B.17.11 City of Venus

5B.17.11.1 Description of Supply

The City of Venus obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates four wells that serve as their sole source water supply. Based on the available groundwater supply, the City of Venus is projected to have a shortage of 323 acft/yr in the year 2030 and 418 acft/yr in the year 2050.

5B.17.11.2 Options Considered

Tale 5B.17-18 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Venus's shortage. Additional alternatives for the City of Venus may include sources in the Trinity River Basin, however, the quantity of water potentially available is not known and these alternatives are not included in this plan. It is recommended that the City of Venus consider sources in the Trinity River Basin (Region C) as well as the strategies shown in Table 5B.17-18.

Table 5B.17-18
Water Management Strategies Considered for the City of Venus

Option	Yield (acft/yr)	Approximate Cost1	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	15	$8,600/yr	$574[2]
Voluntary Redistribution (Section 5A.6)	418	$9,600/yr	$23[3]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	383	$3,670,000	$1,180[4]
No Action	-	N/A[5]	N/A[5]

[1]Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2]Source of Cost Estimate: Section 5A.2.
[3]Source of Cost Estimate: Section 5A.6.
[4]Source of Cost Estimate: Section 5A.16 (prorated for City of Venus). Costs for raw water supply included.
[5]Economic impact of not meeting shortage (i.e. “no action” alternative) was not available.

5B.17.11.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage of the City of Venus:

- Lake Granbury SWATS Expansion
- Voluntary Redistribution from BRA System

5B.17.11.4 Costs

Costs of the recommended plan for the City of Venus to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:

- Cost Source: Sectino 5A.16
- Date to be Implemented: before 2010
- Total Project Cost: $3,670,000
- Annual Cost: $381,000

Table 5B.17-19
Recommended Plan Costs by Decade for the City of Venus

Plan Element	2000	2010	2020	2030	2040	2050
Lake Granbury SWATS Expansion						
Projected Shortage (acft/yr)	(232)	(257)	(293)	(323)	(371)	(418)
Supply from Plan Element (acft/yr)	-	323	323	323	418	418
Annual Cost ($/yr)	-	$381,000	$381,000	$381,000	$181,000	$181,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$433	$433

5B.17.12 County-Other

5B.17.12.1 Description of Supply

Johnson County-Other obtains its water supply primarily from groundwater from the Trinity Aquifer and from surface water from Lake Granbury. One of the largest water supply entities in the county is Johnson County Rural WSC (Johnson Co. Rural WSC). Johnson Co. Rural WSC owns and operates 25 wells that produce water from the Trinity Aquifer and has contracted with the Brazos River Authority for surface water from Lake Granbury. Johnson Co. Rural WSC has contracted with BRA for 6,104 acft/yr for raw water from the BRA System and 2,621 acft/yr of conveyance and treatment capacity from SWATS. Johnson Co. Rural WSC currently does not have the infrastructure to utilize the remaining 3,483 acft/yr of supply from the BRA System. Based on the available groundwater and surface water supply, Johnson County-Other (including Johnson Co. Rural WSC) is projected to have a shortage of 7,054 acft/yr in the year 2030 and 9,046 acft/yr in the year 2050.

5B.17.12.2 Options Considered

Table 5B.17-20 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the Johnson County-Other shortage.

Table 5B.17-20.
Water Management Strategies Considered for Johnson County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	593	$340,000/yr	$574[2]
Voluntary Redistribution (Section 5A.6)	9,046	$208,000/yr	$23[3]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	7,054	$67,608,000	$1,180[4]
Lake Granbury SWATS Expansion (2050) (Section 5A.16)	1,992	$19,092,000	$1,180[4]
No Action	-	$136,652,000[5]	$18,080[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.6.
[4] Source of Cost Estimate: Section 5A.16 (prorated for County-Other). Costs for raw water supply included.
[5] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.12.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage for County-Other:

- Lake Granbury SWATS Expansion
- Voluntary Redistribution from BRA System

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Lake Granbury SWATS Expansion

5B.17.12.4 Costs

Costs of the recommended plan for County-Other to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
- Cost Source: Section 5A.16
- Date to be Implemented: before 2010
- Total Project Cost: $67,608,000
- Annual Cost: $8,324,000

Table 5B.17-21.
Recommended Plan Costs by Decade for County-Other

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Lake Granbury SWATS Expansion						
Projected Shortage (acft/yr)	(4,406)	(5,137)	(3,675)	(7,054)	(8,253)	(9,046)
Supply from Plan Element (acft/yr)	-	7,054	7,054	7,054	9,046	9,046
Annual Cost ($/yr)	-	$8,324,000	$8,324,000	$8,324,000	$3,842,000	$3,842,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$425	$425

5B.17.13 Manufacturing

5B.17.13.1 Description of Supply

Water supply for Manufacturing in Johnson County is obtained by purchase from a city or water supply corporation or from private wells operated by the Manufacturing entity. Each of the cities and the rural area outside of the cities in Johnson County could potentially supply the Manufacturing demand with implementation of a water supply project to meet its needs. Any of the cities or County-Other in Johnson County would have the available water supply to meet all of the projected Manufacturing shortage through development of additional supplies. The plan for additional water supply development in Johnson County is the expansion of the Lake Granbury SWATS facility to meet the regional needs. Therefore, for Manufacturing demands the cost of water supply is participation in the regional project.

5B.17.13.2 Options Considered

Table 5B.17-22 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the Manufacturing shortage.

Table 5B.17-22.
Water Management Strategies Considered for Johnson County Manufacturing

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Voluntary Redistribution (Section 5A.6)	1,839	$42,000/yr	$23[2]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	1,309	$12,546,000	$1,180[3]
Lake Granbury SWATS Expansion (2050) (Section 5A.16)	530	$5,080,000	$1,180[3]
No Action	-	$262,967,000[4]	$200,891[4]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.6.
3 Source of Cost Estimate: Section 5A.16 (prorated for Manufacturing). Costs for raw water supply included.
4 Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.13.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage for Manufacturing:

- Lake Granbury SWATS Expansion
- Voluntary Redistribution from BRA System

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Lake Granbury SWATS Expansion

5B.17.13.4 Costs

Costs of the recommended plan for Manufacturing to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
   - Cost Source: Section 5A.16
   - Date to be Implemented: before 2010
   - Total Project Cost: $12,546,000
   - Annual Cost: $1,545,000

Table 5B.17-23.
Recommended Plan Costs by Decade for Johnson County Manufacturing

Plan Element	2000	2010	2020	2030	2040	2050
Lake Granbury SWATS Expansion						
Projected Shortage (acft/yr)	(640)	(844)	(1,069)	(1,309)	(1,570)	(1,839)
Supply from Plan Element (acft/yr)	-	1,309	1,309	1,309	1,839	1,839
Annual Cost ($/yr)	-	$801,000	$801,000	$801,000	$258,000	$258,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$491	$491

5B.17.14 Steam-Electric

Steam-Electric demand in Johnson County associated with the Tenaska IV Texas Partners Cogeneration Plant in Cleburne. This power generation plant was recently put into service, however, no demand projections were included. Water supply for this facility is obtained primarily from wastewater reuse from the City of Cleburne and a small amount of potable water from the City of Cleburne. No shortages for Steam-Electric are projected and no changes in water supply are recommended.

5B.17.15 Mining

5B.17.15.1 Description of Supply

Mining demand in Johnson County is primarily met from existing groundwater resources. Based on the available groundwater supply, Mining is projected to have a shortage of 33 acft/yr in the year 2030 and 21 acft/yr in the year 2050. These small quantities of water demand will likely be met from local groundwater or municipal supplies. The expansion of the Lake Granbury SWATS facility is recommended as a regional solution for Johnson County and, therefore, for planning purposes it is included as the recommended plan for meeting future Mining shortages.

5B.17.15.2 Options Considered

Table 5B.17-24 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the Mining shortage.

Table 5B.17-24.
Water Management Strategies Considered for Johnson County Mining

Option	***Yield (acft/yr)***	***Approximate Cost[1]***	
		Total	***Unit ($/acft)***
Voluntary Redistribution (Section 5A.6)	33	$759	23[2]
Lake Granbury SWATS Expansion (2030) (Section 5A.16)	33	$316,000	$1,180[3]
No Action	-	$193,000[4]	$3,273[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.6.
[3] Source of Cost Estimate: Section 5A.16 (prorated for Mining). Costs for raw water supply included.
[4] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.17.15.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage for Mining:

- Lake Granbury SWATS Expansion
- Voluntary Redistribution

5B.17.15.4 Costs

Costs of the recommended plan for Mining to meet 2030 shortages are:

a. Lake Granbury SWATS Expansion:
   - Cost Source: Section 5A.16
   - Date to be Implemented: before 2030
   - Total Project Cost: $316,000
   - Annual Cost: $39,000

Table 5B.17-25.
Recommended Plan Costs by Decade for Johnson County Mining

Plan Element	2000	2010	2020	2030	2040	2050
Lake Granbury SWATS Expansion						
Projected Shortage (acft/yr)	(238)	(111)	(57)	(33)	(17)	(21)
Supply from Plan Element (acft/yr)	-	33	33	33	33	33
Annual Cost ($/yr)	-	$39,000	$39,000	$39,000	$7,000	$7,000
Unit Cost ($/acft)	-	$1,180	$1,180	$1,180	$212	$212

5B.17.16 Irrigation

No shortage is projected for Johnson County Irrigation and no changes in water supply are recommended.

5B.17.17 Livestock

No shortage is projected for Johnson County Livestock and no changes in water supply are recommended.

5B.18 Jones County Water Supply Plan

Table 5B.18-1 lists each water user group in Jones County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Jones County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plan described below either includes specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.18-1.
Jones County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Abilene	0	0	City is in multiple counties. Projections shown are for Jones County only
City of Anson	1,492	1,459	Projected surplus
City of Hamlin	(714)	(766)	Projected shortage – see plan below
City of Hawley	0	0	Additional demand and supply for the remainder of Hawley WSC's service area is included in County-Other
City of Stamford	(372)	(161)	See plan below
County-Other	(93)	(88)	Projected shortage – see plan below
Manufacturing	(380)	(436)	Projected shortage – see plan below
Steam-Electric	(3,824)	(3,824)	Projected shortage – see plan below
Mining	577	577	Projected surplus
Irrigation	4,037	4,242	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-35 and 4-36, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.18.1 The City of Abilene

The majority of the use for the City of Abilene is in Taylor County and the recommended plan is described in Section 5B.33.

5B.18.2 The City of Anson

The City of Anson obtains water from Hubbard Creek Reservoir. It has a projected surplus for the study period and no water plan recommendations were developed.

5B.18.3 The City of Hamlin

5B.18.3.1 Description of Supply

The City of Hamlin uses Lake Stamford for a water supply, which is purchased from the City of Stamford. The City of Hamlin's contract for water supply from Lake Stanford expires in 2005 and is not planned for renewal. The projected shortage in 2030 is 714 acft.

5B.18.3.2 Options Considered

Table 5B.18-2 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Hamlin's shortages.

Table 5B.18-2.
Water Management Strategies Considered for City of Hamlin

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Voluntary redistribution from Anson and Abilene (Section 5A.20.3)	767	$5,500,000	$927
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629[2]
No Action	-	$2,249,000[3]	$42,443[3]

[1] Treated water cost delivered to Hamlin.
[2] Raw water cost in the reservoir.
[3] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.18.3.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Hamlin:

- Voluntary redistribution from Anson and Abilene to supply an additional 767 acft/yr of treated water. This will replace the current water supply system.

The Breckenridge Reservoir has been recommended for the long-term needs of West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.18.3.4 Costs

Costs of the Recommended Plan for the City of Hamlin to meet 2030 shortages are:

a. Voluntary redistribution from Anson and Abilene:
   - Cost Source: Section 5A.20.3, Table 5A.20-8
   - Date to be Implemented: before 2010
   - Total Project Cost: $5,500,000
   - Total Annual Cost: $711,000

Table 5B.18-3.
Recommended Plan Costs by Decade for the City of Hamlin

Plan Element	2000	2010	2020	2030	2040	2050
Projected Shortage (acft/yr)	(24)	(691)	(694)	(714)	(735)	(766)
Supply from Plan Elements (acft/yr)	0	767	767	767	767	767
Annual Cost ($/yr)	0	$711,000	$711,000	$711,000	$314,000	$314,000
Unit Cost ($/acft)[1]	0	$927	$927	$927	$409	$409

[1] Unit cost is for full utilization of capacity. Operation and maintenance of existing facilities is not included.

5B.18.4 The City of Hawley

The City of Hawley is supplied with surface water from the City of Abilene and the City of Anson. No shortages are projected and no changes in water supply are recommended.

5B.18.5 City of Stamford

5B.18.5.1 Description of Supply

The City of Stamford obtains its surface water supply from Lake Stamford, the yield of which is declining due to sedimentation. The projections for Stamford are the firm yield of Lake Stamford plus their contract to purchase water from the City of Abilene, less their contracts to sell water to the City of Hamlin, City of Lueders, Ericksdahl WSC, Paint Creek WSC, and Sagerton WSC.

5B.18.5.2 Options Considered

Table 5B.18-4 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Stamford's shortages.

Table 5B.18-4.
Water Management Strategies Considered for City of Stamford

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Diversion from California Creek to Lake Stamford (Section 5A.7.2)	3750	$6,300,000	$171
Wastewater Reuse (Section 5A.3)	80	$323,083	$326
Additional Conservation (Section 5A.2)	59	$34,000/yr	$574
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629[1]
No Action	-	$31,748,000[2]	$42,443[2]

[1] Raw water cost in the reservoir.
[2] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.18.5.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Stamford:

- Diversion from California Creek to Lake Stamford to supply an additional 1825 acft/yr, which is half of the icnrease in yield. The other half is allocated to West Texas Utilities in Haskell County for steam-electric use.
- Wastewater Reuse
- Conservation

The Breckenridge Reservoir has been recommended as a major water provider for the long-term needs of West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.18.5.4 Costs

Costs of the Recommended Plan for the City of Stamford to meet 2030 shortages are:

a. Diversion from California Creek to Lake Stamford:
   - Cost Source: Section 5A.7.2
   - Date to be Implemented: 2001
   - Total Project Cost: $6,300,000
   - Total Annual Cost: $171/acft

b. Wastewater Reuse
   - Cost Source: Section 5A.3
   - Date to be Implemented: before 2010
   - Total Project Cost: $323,000

c. Conservation
   - Cost Source: Section 5A.2
   - Date to be Implemented: before 2010
   - Total Annual Cost: $574/acft

Table 5B.18-5.
Recommended Plan Costs by Decade for the City of Stamford

Plan Element	2000	2010	2020	2030	2040	2050
Projected Surplus/(Shortage (acft/yr)	(509)	533	469	372	274	161
Diversion from California Creek to Lake Stamford						
Supply From Plan Element (acft/yr)	0	1,875	1,875	1,875	1,875	1,875
Annual Cost ($/yr)	$0	$320,000	$320,000	$320,000	$65,000	$65,000
Unit Cost ($/acft)	$0	$171	$171	$171	$35	$35
Wastewater Reuse						
Supply From Plan Element (acft/yr)	0	80	80	80	80	80
Annual Cost ($/yr)	$0	$26,000	$26,000	$26,000	$2,600	$2,600
Unit Cost ($/acft)	$0	$326	$326	$326	$32	$32
Conservation						
Supply From Plan Element (acft/yr)	0	59	59	59	59	59
Annual Cost ($/yr)	$0	$34,000	$34,000	$34,000	$34,000	$34,000
Unit Cost ($/acft)[1]	$0	$574	$574	$574	$574	$574
Total New Supply (acft/yr)	0	2,014	2,014	2,014	2,014	2,014

5B.18.6 County-Other Category

5B.18.6.1 Options Considered

Table 5B.18-6 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the County-Other category.

Table 5B.18-6.
Water Management Strategies Considered for Jones County-Other

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Voluntary redistribution from Abilene, Anson, or Stamford	180	$117,000/yr	$650[1]
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629[2]
No Action	-	$1,681,000[3]	$18,080[3]

[1] Estimated wholesale rate for treated water.
[2] Raw water cost in the reservoir.
[3] Economic Impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.18.6.2 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage of the County-Other category:

- Voluntary redistribution from Abilene, Anson, or Stamford, as appropriate, providing an additional 180 acft/yr.

The Breckenridge Reservoir has been recommended as a major water provider for long-term needs of the West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.18.6.3 Costs

Costs of the Recommended Plan for the County-Other category to meet 2030 shortages are:

a. Voluntary redistribution from Anson, Abilene, or Stamford:
   - Cost Source: Estimated wholesale rate of $650/acft for treated water
   - Date to be Implemented: 2010
   - Total Annual Cost: $117,000

5B.18.7 Manufacturing

5B.18.7.1 Description of Supply

Currently there is no supply for Manufacturing.

5B.18.7.2 Options Considered

Table 5B.18-7 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the Manufacturing category's shortages.

Table 5B.18-7.
Water Management Strategies Considered for Jones County Manufacturing

Option	*Yield (acft/yr)*	*Approximate Cost*	
		Total	*Unit ($/acft)*
Voluntary redistribution of Municipal supply	380	$0	$0
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629
No Action	-	$32,256,000[1]	$84,884[1]

[1] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.18.7.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Manufacturing category:

- Voluntary redistribution of Municipal supply providing an additional 380 acft/yr

The Breckenridge Reservoir has been recommended as a major water provider for the long-term needs of the West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.18.7.4 Costs

Costs of the Recommended Plan for the Manufacturing category to meet 2030 shortages are:

a. Voluntary redistribution of Municipal supply:
   - Cost Source: Estimated wholesale rate of $650/acft for treated water
   - Date to be Implemented: In place
   - Total Annual Cost: $0

5B.18.8 Steam-Electric

5B.18.8.1 Description of Supply

Surface water supply for Steam-Electric power is provided by Lake Fort Phantom Hill for the West Texas Utilities power plant.

5B.18.8.2 Options Considered

Table 5B.18-8 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the Steam-Electric category's shortages.

Table 5B.18-8.
Water Management Strategies Considered for Jones County Steam-Electric

Option	*Yield (acft/yr)*	*Approximate Cost*	
		Total	*Unit ($/acft)*
Redistribution from Municipal Supply of Abilene	3,824	$0	$0
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462	$629
No Action	-	$17,979,000*	$4,701*

* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.18.8.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Steam-Electric category:

- Redistribution from Municipal Supply of Abilene.

The Breckenridge Reservoir has been recommended as a major water provider for long-term needs of West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.18.8.4 Costs

Costs of the Recommended Plan for the Steam-Electric category to meet 2030 shortages are:

a. Redistribution from Municipal Supply of Abilene:
   - No modifications to existing system needed
   - Date to be Implemented: In place
   - Total Annual Cost: $0

5B.18.9 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.18.10 Irrigation

No shortages are projected for Jones County Irrigation and no changes in water supply are recommended.

5B.18.11 Livestock

No shortages are projected for Jones County Livestock and no changes in water supply are recommended.

5B.19 Kent County Water Supply Plan

Table 5B.19-1 lists each water user group in Kent County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Kent County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plans described below either include specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.19-1.
Kent County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Jayton	175	201	Projected surplus
County-Other	119	126	Projected surplus
Manufacturing	0	0	No demand or supply
Steam-Electric	0	0	No demand or supply
Mining	2,483	2,571	Projected surplus
Irrigation	1,824	1,856	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-37 and 4-38, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.19.1 The City of Jayton

5B.19.1.1 Description of Supply

Water supply for the City of Jayton is groundwater from Seymour and Dockum Aquifers. No current or future shortages are projected. Therefore, no change in water supply uses are projected or recommended.

5B.19.1.2 Water Supply Plan

For the long-term period beyond 2030, the following water management strategies are recommended; based on recommendations from local officials:

- New reservoir on Duck Creek (though no study has been performed on the viability of this project)

5B.19.2 County-Other Category

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.19.3 Manufacturing

No Manufacturing demand exists or is projected for the county.

5B.19.4 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.19.5 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.19.6 Irrigation

No shortages are projected for Kent County Irrigation and no changes in water supply are recommended.

5B.19.7 Livestock

No shortages are projected for Kent County Livestock and no changes in water supply are recommended.

5B.20 Knox County Water Supply Plan

Table 5B.20-1 lists each water user group in Knox County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Knox County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plans described below either include specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.20-1.
Knox County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Benjamin	31	28	Projected surplus
Knox City	(235)	(235)	Projected shortage – see plan below
City of Munday	(294)	(295)	Projected shortage – see plan below
County-Other	5	5	Projected surplus
Manufacturing	0	0	No demand or supply
Steam-Electric	0	0	No demand or supply
Mining	8	9	Projected surplus
Irrigation	(2,199)	(799)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4-39 and 4-40, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.20.1 City of Benjamin

Small surface water supplies are obtained from Millers Creek Reservoir and local sources, but primary groundwater sources are the Seymour and Blaine Aquifers. The groundwater supply is limited by well capacity. No current or future shortages are projected and no changes in water supply are recommended.

5B.20.2 Knox City

5B.20.2.1 Description of Supply

Knox City obtains surface water via a contract with North Central Texas MWD. This contract expires in 2010, however, the supply is limited. Knox has a projected shortage of 235 acft in 2030, representing 100 percent of demand.

5B.20.2.2 Options Considered

Table 5B.20-2 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting Knox City's shortages.

Table 5B.20-2.
Water Management Strategies Considered for Knox City

Option	*Yield (acft/yr)*	*Approximate Cost*	
		Total	*Unit ($/acft)*
Extend existing contract with NCTMWD	235	$152,750/yr	$650[1]
No Action	-	$9,974,000*	$42,443*

[1] Estimated wholesale rate for treated water.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.20.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of Knox City:

- Extend and amend existing contract to supply an additional 235 acft/yr

5B.20.2.3 Costs

Costs of the Recommended Plan for Knox City.

a. Extension of existing contract:
   - Cost Source: Estimated wholesale of $650/acft for treated water
   - Date to be Implemented: 2010
   - Total Annual Cost: $152,750

5B.20.3 City of Munday

5B.20.3.1 Description of Supply

The City of Munday obtains surface water via a contract with North Central Texas MWD. This contract expires in 2010; however, the supply is limited. Munday has a projected shortage of 291 acft in 2030, this represents 100 percent of demand.

5B.20.3.2 Options Considered

Table 5B.20-3 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Munday's shortages.

Table 5B.20-3.
Water Management Strategies Considered for the City of Munday

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Extend existing contract with NCTMWD	295	$191,750/yr	$650[1]
No Action	-	$12,478,000*	$42,443*

1 Estimated wholesale rate for treated water.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.20.3.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of Munday:

- Extend and amend existing contract to supply an additional 294 acft/yr.

5B.20.3.4 Costs

Costs of the Recommended Plan for Munday.

a. Extension of existing contract:
   - Cost Source: Estimated wholesale value of $650/acft for treated water
   - Date to be Implemented: 2010
   - Total Annual Cost: $191,100

5B.20.4 County-Other Category

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.20.5 Manufacturing

No Manufacturing demand exists or is projected for the county.

5B.20.6 Steam-Electric

There is no Steam-Electric demand or supply in Knox County.

5B.20.7 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.20.8 Irrigation

5B.20.8.1 Description of Supply

Surface water supplies for Irrigation in Knox County are obtained from Wild Horse Creek, Lake Catherine, and Lake Davis. The estimated annual reliable surface water supply for Irrigation is 2,064 acft until 2050. The primary groundwater source in Knox County is the Seymour Aquifer. Estimated reliable supply of groundwater is 25,000 acft until 2050. As demonstrated in Table 5B.20-1, there is a current and long-term shortage in Irrigation water supplies through the year 2050.

5B.20.8.2 Options Considered

Table 5B.20-4 lists the water management strategies that were considered for Knox County Irrigation shortages, total project cost, and unit costs for meeting the shortage.

Table 5B.20-4.
Water Management Strategies Considered for Knox County Irrigation

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Irrigation System Conversion [1]	2,200	$96,800/yr	$44
Brush Control	(*)	(*)	(*)
Weather Modification [2]	(*)	$500,000 to $850,000/yr	(*)
No Action	-	$318,000[3]	$144[3]

[1] Source of Cost Estimate: Texas Agriculture Experiment Station
[2] Source of Cost Estimate: Section 5B.10.
[3] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.
* Definitive yield and/or cost cannot be determined.

5B.20.8.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Irrigation category.

Knox County has a projected Irrigation shortage of 2,199 acft in 2030 and 779 acft in 2050. No new water supplies are economically feasible to meet this projected shortage. Water conservation strategies in the form of conversion to irrigation systems with increased efficiency could supply some of the unmet demands. The options are to upgrade the gated pipe systems to center pivot systems and to upgrade older center pivots. Conversion of 2,000 acres of the 19,500 acres of irrigated cotton in Knox County from gated pipe to center pivot could meet the projected shortage in 2030.

As shown in Table 5B.20-5, conservation practices can meet about 2,200 acft/yr of the projected shortages. This will meet the projected shortages by the year 2030. Prior to that, it is not economically feasible to meet projected Irrigation shortages in Knox County.

5B.20.8.4 Costs

Costs of the Recommended Plan for Knox County Irrigation supply are outlined in Table 5B.20-5. Costs for some options, such as brush control and weather modification, can not be directly quantified due to lack of specific data. Costs for these options have been estimated based on generally available data outlined in the corresponding chapter in Section 5B. Conversion of 2,000 acres of the 19,500 acres of irrigated cotton in Knox County from gated pipe to center pivot could meet the projected shortage in 2030. This would conserve 1.11 acft water per acre at an average annual cost of $44.11/acft and it would provide 2,200 acft/yr.

Table 5B.20-5.
Recommended Plan Costs by Decade for Knox County Irrigation[1]

Plan Element	2000	2010	2020	2030	2040	2050
Irrigation System Conversion[2]						
Projected Shortage (acft/yr) [3]	(4,465)	(3,691)	(2,936)	(2,199)	(1,480)	(779)
Supply from Plan Element (acft/yr)	2,200	2,200	2,200	2,200	2,200	2,200
Annual Cost ($/yr)	$96,800	$96,800	$96,800	$96,800	$96,800	$96,800
Unit Cost ($/acft)	$44	$44	$44	$44	$44	$44
Weather Modification[4]						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Brush Control[4]						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Sum of Supply from Plan Elements (acft/yr)	2,200	2,200	2,200	2,200	2,200	2,200
Unmet Demand [5]	(2,265)	(1,491)	(736)	0	0	0

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for water conserved through management practices. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Texas Agriculture Experiment Station
[3] Total projected irrigation shortages are presented.
[4] Source of Cost Estimate: Section 5B.10.
[5] Apart from the conservation options presented, it is not economically feasible to meet projected irrigation shortages listed as unmet demand in Knox County.
* Definitive yield and/or cast cannot be determined.

5B.20.9 Livestock

No future shortages are projected in the Livestock category and no changes in water supply are recommended.

5B.21 Lampasas County Water Supply Plan

Table 5B.21-1 lists each water user group in Lampasas County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.21-1.
Lampasas County Surplus/(Shortage)

Water User Group	*Surplus/(Shortage)*[1] *2030 (acft/yr)*	*2050 (acft/yr)*	*Comment*
City of Lampasas	(544)	(1,501)	Projected shortage – see plan below
City of Lometa	333	325	Projected surplus
County-Other	2,435	2,204	Projected surplus
Manufacturing	(108)	(128)	Projected shortage – see plan below
Steam-Electric	0	0	No Projected Need
Mining	963	953	Projected surplus
Irrigation	1,354	1,358	Projected surplus
Livestock	1,259	1,259	No Projected Need

[1] From Tables 4-41 and 4-42, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.21.1 City of Lampasas

5B.21.1.1 Description of Supply

The City of Lampasas is supplied water by Central Texas WSC through Kempner WSC transmission facilities, with water from Stillhouse Hollow Reservoir. Current total capacity of delivery systems from Central Texas WSC and Kempner WSC is limited to 2,000 acft/yr.

5B.21.1.2 Options Considered

The City of Lampasas has a shortage of 544 acft per year in 2030, which is about 21 percent of demand. Table 5B.21-2 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for meeting the City of Lampasas shortage.

Table 5B.21-2.
Water Management Strategies Considered for the City of Lampasas

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
Additional Water Conservation (Section 5A.2)	127	$70,000/year	$574[2]
Increase conveyance capacity by Kempner WSC to supply all of Lampasas contracted supply from Stillhouse Hollow Reservoir	1,500	$5,797,000	$304
Wastewater Reuse (Section 5A.3)	350	$1,413,000	$326
No Action	-	$33,491,000*	$61,565*

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
* Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.21.1.3 Water Supply Plan

The following plan meets the planning criteria established by the Brazos G RWPG.

- Increase conveyance capacity by Kempner WSC
- Wastewater Reuse for non-potable water needs

5B.21.1.4 Costs

Costs of the Recommended Plan for the City of Lampasas.

a. Increased supply from Central Texas WSC and Kempner WSC:

Previous analysis has indicated that the current delivery system (30-in., 27-in., 24-in, 20-in., and 18-in. diameter transmission pipelines) could deliver contracted water quantities by increasing pressure and delivery velocities. This would increase operating costs and possibly require a booster station improvement. Existing facilities may or may not be the end of their useful life at the time additional delivery capacity is needed. Therefore, the cost of replacement facilities are shown in the water plan, but they may not be actually needed.

- Cost Source: Cost Estimate for replacing or paralleling existing section of pipe.
- Date to be Implemented: 2015
- Total Project Cost: $5,797,000
- Annual Cost: $456,000

  The Cost Estimate includes: Replacing or paralleling existing 24-in. dia. transmission pipeline with approximately 42,500 feet of 30-in. dia. transmission pipeline and *approximately 7,000 feet of 36-in. dia. transmission pipeline. The cost estimate also includes increasing booster station capacity and increased pumping energy costs.*

b. Water Reuse System:

- Cost Source: Section 5A.3
- Date to be Implemented: 2020
- Total Project Cost: $1,413,000
- Annual Cost: $114,000

Table 5B.21-3.
Recommended Plan Costs by Decade for the City of Lampasas

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Infrastructure Expansion						
Projected Shortage (acft/yr)	122	126	(185)	(544)	(977)	(1,501)
Supply From Plan Element (acft/yr)	- -	- -	1,500	1,500	1,500	1,500
Annual Cost ($/yr)	- -	- -	$456,000	$456,000	$456,000	$456,000
Unit Cost ($/acft)	- -	- -	$304	$304	$304	$304
Wastewater Reuse						
Supply From Plan Element (acft/yr)	- -	- -	350	350	350	350
Annual Cost ($/yr)	- -	- -	$114,000	$114,000	$114,000	$11,400
Unit Cost ($/acft)	- -	- -	$326	$326	$326	$32

5B.21.2 City of Lometa

5B.21.2.1 Description of Supply

City of Lometa is supplied water by Lometa WSC, which recently was acquired by the Lower Colorado River Authority. The LCRA has contracted to supply water from the Colorado River to Lometa and is in the process of building new facilities to supply the area. No change is recommended in the water supply situation.

5B.21.3 County-Other

No shortage is projected for Lampasas County-Other entities and no changes in water supply are recommended.

5B.21.4 Manufacturing

Water supply for Manufacturing in Lampasas County is obtained by purchase from a city or water supply corporation or from private wells operated by the manufacturing entity. New manufacturing facilities would be expected to locate where existing water supplies are available, such as near a city or within the service area of an existing water supply corporation. County-Other has available supply to meet Manufacturing shortages and Lampasas will have sufficient supply once they implement the recommended water plan.

5B.21.5 Steam-Electric

No Steam-Electric demand exists or is projected for Lampasas County.

5B.21.6 Mining

No shortages are projected for Lampasas County Mining and no changes in water supply are recommended.

5B.21.7 Irrigation

No shortages are projected for Irrigation and no changes in water supply are recommended.

5B.21.8 Livestock

No shortages are projected for Livestock and no changes in water supply are recommended.

5B.22 Lee County Water Supply Plan

Table 5B.22-1 lists each water user group in Lee County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.22-1.
Lee County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Giddings	(337)	(542)	Projected Shortage – see plan below
City of Lexington	648	615	Projected Surplus
County-Other	10,557	10,332	Projected Surplus
Manufacturing	17	14	Projected Surplus
Steam-Electric	0	0	No Projected Need
Mining	8	13	Projected Surplus
Irrigation	1,563	1,577	Projected Surplus
Livestock	2,478	2,478	Projected Surplus

[1] From Tables 4-43 and 4-44, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.22.1 City of Giddings

5B.22.1.1 Description of Supply

The City of Giddings obtains its water supply from groundwater from the Carrizo-Wilcox Aquifer. The City owns and operates six wells that produce water from the Carrizo-Wilcox Aquifer that serves as its sole source supply. The water supply available from the Carrizo-Wilcox Aquifer is sufficient to meet the City's demands, however, the City's ability to meet demands in the year 2030 is projected to be constrained by the capacity of the wells.

5B.22.1.2 Options Considered

The City of Giddings has a shortage of 337 acft per year in 2030, which is about 12 percent of projected demand. Table 5B.22-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Giddings shortage.

Table 5B.22-2.
Water Management Strategies Considered for the City of Giddings

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	80	$46,000/year	$574[2]
Further Development of Carrizo/Wilcox Aquifer	542	$613,000[3]	$136[3]
No Action	--	$15,635,000[4]	$46,394[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Cost of adding a new well to existing system.
[4] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.22.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage of the City of Giddings:

- Further development of Carrizo-Wilcox Aquifer

5B.22.1.4 Costs

Costs of the recommended plan for the City of Giddings to meet 2030 shortages are:

a. Further Development of Carrizo – Wilcox Aquifer:
   - Cost Source: New cost estimate of adding a new well
   - Date to be Implemented: By Year 2010
   - Total Project Cost: $613,000
   - Annual Cost: $75,000

   The Cost Estimate includes 1,000 feet of 8-inch diameter pipeline, and the construction of a 500 gpm, 1,500 foot deep well.

Table 5B.22-3.
Recommended Plan Costs by Decade for the City of Giddings

Plan Element	2000	2010	2020	2030	2040	2050
Aquifer Development						
Projected Shortage (acft/yr)	(109)	(183)	(253)	(337)	(426)	(542)
Supply From Plan Element (acft/yr)	-	550	550	550	550	550
Annual Cost ($/yr)	-	$75,000	$75,000	$75,000	$31,000	$31,000
Unit Cost ($/acft)	-	$136	$136	$136	$56	$56

5B.22.2 City of Lexington

The City of Lexington obtains its water supply from groundwater from the Carrizo-Wilcox Aquifer. The city owns and operates two wells that are projected to supply the needs of the City of Lexington through the year 2050. No shortages are projected for the City of Lexington and no changes in water supply are recommended.

5B.22.3 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.22.4 Manufacturing

Manufacturing is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.22.5 Steam-Electric

No Steam-Electric demand exists nor is projected for the county.

5B.22.6 Mining

Projected Mining demand in Lee County is primarily associated with Alcoa and the plan to mine additional areas in Lee County. The operation includes depressurization of the groundwater in the layer below the underground lignite formation in order to extract the lignite resource. The water supply available is essentially the amount of water that is produced in the depressurization operation. This operation is largely non-consumptive and the water produced is available for other uses. The San Antonio Water System (SAWS), located in the South Central Texas Region (L), has contracted to purchase Carrizo-Wilcox Aquifer groundwater produced from land owned or leased by Alcoa in Milam, Lee, and Bastrop Counties. The Region L water plan calls for 55,000 acft/yr to be purchased through this contract. Water to be sold by Alcoa originates primarily from their ongoing lignite mining activities. Table 4-43A reports water quantities to be delivered from Lee County to SAWS consistent with the water plan being prepared by the South Central Texas Region RWPG. No shortages for Mining use are projected through the year 2050.

5B.22.7 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.22.8 Livestock

Livestock is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.23 Limestone County Water Supply Plan

Table 5B.23-1 lists each water user group in Limestone County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.23-1.
Limestone County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Coolidge	82	88	Projected surplus
City of Groesbeck	(756)	(874)	Projected shortage – see plan below
City of Kosse	659	663	Projected surplus
City of Mexia	227	107	Projected surplus
City of Thornton	166	166	Projected surplus
County-Other[2]	16,614	14,989	Projected surplus
Manufacturing	(777)	(1,059)	Projected shortage – see plan below
Steam-Electric	7,458	7,458	Projected surplus
Mining	6,868	6,630	Projected surplus
Irrigation	13	13	Projected surplus
Livestock	99	99	Projected surplus

[1] From Tables 4-45 and 4-46, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.
[2] Although a county-wide surplus is projected in the County-other category, Bistone WSD has indicated the need for projects to meet local shortages.

5B.23.1 City of Coolidge

The City of Coolidge obtains its water supply from Navarro Mills Reservoir through service from Post Oak Special Utility District. The City is also interconnected with the Bistone WSD. The City of Coolidge has contracted for sufficient water supply to meet its needs through the year 2050.

5B.23.2 City of Groesbeck

5B.23.2.1 Description of Supply

The City of Groesbeck obtains its water supply from the Navasota River. The City owns senior water rights (priority date of 1921) on the Navasota River and has limited storage available from Springfield Lake. The firm supply of the City's system was computed to be 152 acft/yr which is significantly less than their projected year 2030 water demand of 908 acft/yr. The City has had water supply problems in the past and has implemented water rationing in recent summer periods.

5B.23.2.2 Options Considered

Table 5B.23-2 lists the water management strategies that were considered for meeting the City of Groesbeck's shortage, and references the report section discussing the strategy, total project cost, and unit costs.

Table 5B.23-2.
Water Management Strategies Considered for the City of Groesbeck

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation – City of Groesbeck	50	$29,000/yr	574
Groesbeck Off-Channel Reservoir (Section 5A.15)	1,500	$4,173,000[2]	241[2]
Carrizo-Wilcox Aquifer Development – City of Groesbeck	874	$7,088,000[3]	731[3]
No Action	-	$35,074,000*	$46,394*

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.15-5.
3 Cost estimated based on development of a new well field east of the City of Groesbeck with treatment and transmission to the City's system.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.23.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 and 2050 shortage of the City of Groesbeck:

- Groesbeck Off-Channel Reservoir

- Construction of an off-channel reservoir near the Groesbeck WTP by the year 2010 to provide additional storage and yield during times of drought.

5B.23.2.4 Costs

Costs of the Recommended Plan for the City of Groesbeck.

a. Item 1:
- Cost Source: Section 5.15, Table 5.15-5
- Date to be Implemented: 2010
- Total Project Cost: $4,173,000

Table 5B.23-3.
Recommended Plan Costs by Decade for the City of Groesbeck

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Off-Channel Reservoir						
Projected Shortage (acft/yr)	(174)	(177)	(196)	(218)	(246)	(281)
Quantity Available (acft/yr)	0	1,500	1,500	1,500	1,500	1,500
Annual Cost ($/yr)	0	$362,000	$362,000	$362,000	$59,000	$59,000
Unit Cost ($/acft)	0	$241	$241	$241	$39	$39

5B.23.3 City of Kosse

The City of Kosse obtains its water supply from groundwater by purchase from the Tri-County WSC. The City of Kosse has contracted for sufficient water supply to meet its needs through the year 2050.

5B.23.4 City of Mexia

The City of Mexia obtains its water supply from groundwater and surface water from the Bistone Water Supply District. The groundwater supply from the Simsboro Aquifer serves as the primary supply for the City and surface water from Lake Mexia serves as a secondary supply. The City of Mexia has contracted for sufficient water supply to meet its needs through the year 2050.

5B.23.5 City of Thornton

The City of Thornton obtains its water supply from groundwater from the Carrizo-Wilcox Aquifer. The city owns and operates two wells that are projected to supply the needs of the City of Thornton through the year 2050. No shortages are projected for the City of Thornton and no changes in water supply are recommended.

5B.23.6 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended. The Bistone WSD has indicated that near-term projects will be needed to meet expected local demands on the Bistone WSD system.

5B.23.6.1 Description of Supply (Bistone WSD)

Water supply for Bistone WSD is obtained from groundwater from the Carrizo-Wilcox Aquifer (Personville Well Field) and from surface water from Lake Mexia. Bistone WSD supplies the City of Mexia and several county-other entities including the Mexia State School, White Rock WSC No. 1, and the City of Tehuacana. Bistone WSD also supplies several entities through the City of Mexia's system including 84 West WSC, Old Fort Parker State Park, Point Enterprise WSC, Shiloh WSC, White Rock WSC-Forest Glade, City of Wortham, and White Rock WSC No. 3. The supply available from Lake Mexia is declining due to sedimentation and the district has indicated that they plan to expand the groundwater production capacity from the Carrizo-Wilcox Aquifer.

5B.23.6.2 Water Supply Plan

In anticipation of possible future shortages, the Bistone WSD is planning to drill three additional wells in the Carrizo-Wilcox Aquifer. In addition to the three additional wells, the existing treatment plant will require expansion.

5B.23.6.3 Costs

Costs of the Recommended Plan for the Bistone WSD.

a. Item 1:
    - Cost Source: Estimated cost for installation of three new wells in the Carrizo-Wilcox Aquifer and expansion of the existing water treatment plant by 0.5 MGD.
    - Date to be Implemented: 2010
    - Total Project Cost: $1,428,000

Table 5B.23-4.
Recommended Plan Costs by Decade for the Bistone WSD

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Additional Development of Carrizo-Wilcox Aquifer						
Quantity Available (acft/yr)	0	725	725	725	725	725
Annual Cost ($/yr)	0	$199,000	$199,000	$199,000	$95,000	$95,000
Unit Cost ($/acft)	0	$274	$274	$274	$131	$131

5B.23.7 Manufacturing

Water supply for Manufacturing in Limestone County is obtained by purchase from a city or rural water supply entity or from private wells operated by the Manufacturing entity. Each of the cities, except for the City of Groesbeck, and the County-Other entities have surplus supplies available through the year 2050. New manufacturing facilities would be expected to locate where existing water supplies are available, such as near a city or within the service area of an existing water supply corporation. Water supply for Manufacturing is projected to be obtained from existing supplies of the cities and County-Other entities in Limestone County.

5B.23.8 Steam-Electric

Steam-Electric water demand in Limestone County is associated with the Reliant Energy Power Plant located at Lake Limestone. Reliant Energy has contracted with the Brazos River Authority for water supply from Lake Limestone in sufficient quantity to exceed its needs through the year 2050. No shortage is projected for Steam-Electric and no changes in water supply are recommended.

5B.23.9 Mining

Mining is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.23.10 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended. Additional supply may be available for Irrigation use through implementation of the Big Creek Watershed Project.

5B.23.11 Livestock

Livestock is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended. Additional supply may be available for Livestock use through implementation of the Big Creek Watershed Project.

5B.24 McLennan County Water Supply Plan

Table 5B.24-1 lists each water user group in McLennan County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.24-1.
McLennan County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)1		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Bellmead	137	137	Projected surplus
City of Beverly Hills	0	0	Projected surplus
City of Bruceville-Eddy	33	33	Projected surplus
City of Crawford	93	109	Projected surplus
City of Gholson	24	29	Projected surplus
City of Hewitt	136	136	Projected surplus
City of Lacy-Lakeview	65	65	Projected surplus
City of Lorena	602	508	Projected surplus
City of Mart	37	0	Projected surplus
City of McGregor	(313)	(360)	Projected shortage – see plan below
City of Moody	232	233	Projected surplus
City of Northcrest	24	24	Projected surplus
City of Riesel	21	39	Projected surplus
City of Robinson	(551)	(615)	Projected shortage – see plan below
City of Valley Mills	1	1	Projected surplus
City of Waco	25,434	19,194	Projected surplus; possible regional provider – see plan below
City of West	(399)	(378)	Projected shortage – see plan below
City of Woodway	233	233	Projected surplus
County-Other	(4,029)	(3,785)	Projected shortage – see plan below
Manufacturing	(4,384)	(5,617)	Projected shortage – see plan below
Steam-Electric	0	0	No Projected Needs
Mining	(1,071)	(1,322)	Projected shortage – see plan below
Irrigation	22,267	22,267	Projected surplus
Livestock	0	0	No Projected Needs

[1] From Tables 4-24 and 4-48, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.24.1 City of Bellmead

The City of Bellmead obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates four wells that serve as the city's primary supply. The City of Bellmead also has contracted with the City of Waco for supplemental surface water supply from Lake Waco. No shortages are projected for the City of Bellmead and no changes in water supply are recommended.

5B.24.2 City of Beverly Hills

The City of Beverly Hills obtains its water supply from surface water from the City of Waco. No shortages are projected for the City of Beverly Hills and no changes in water supply are recommended.

5B.24.3 City of Bruceville-Eddy

The City of Bruceville-Eddy obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates three wells that serve as the primary supply. The City of Bruceville-Eddy also has contracted for surface water from Lake Belton from Bluebonnet WSC. No shortages are projected for the City of Bruceville-Eddy and no changes in water supply are recommended.

5B.24.4 City of Crawford

The City of Crawford obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates two wells that serve as the city's sole source supply. No shortages are projected for the City of Crawford and no changes in water supply are recommended.

5B.24.5 City of Gholson

The City of Gholson obtains its water supply from groundwater from the Trinity Aquifer. The city owns and operates two wells that serve as the city's sole source supply. No shortages are projected for the City of Gholson and no changes in water supply are recommended.

5B.24.6 City of Hewitt

The City of Hewitt obtains its water supply from groundwater from the Trinity Aquifer. The City owns and operates five wells that serve as the City's primary supply. The City of Hewitt also has contracted with the City of Waco for supplemental surface water supply from Lake Waco. No shortages are projected for the City of Hewitt and no changes in water supply are recommended.

5B.24.7 City of Lacy-Lakeview

The City of Lacy-Lakeview obtains its water supply from groundwater from the Trinity Aquifer and from surface water from Lake Waco. The City owns and operates one well and has contracted with the City of Waco for supplemental surface water supply from Lake Waco. No shortages are projected for the City of Bellmead and no changes in water supply are recommended.

5B.24.8 City of Lorena

The City of Lorena obtains its water supply from groundwater from the Trinity Aquifer. The City owns and operates two wells that serve as the City's sole source supply. No shortages are projected for the City of Lorena and no changes in water supply are recommended.

5B.24.9 City of Mart

The City of Mart obtains its water supply from groundwater from the Trinity Aquifer and from surface water from Lake Mart. The City owns and operates one well and treats and distributes water from Lake Mart to meet peak demands. No shortage is projected for the City of Mart and no changes in water supply are recommended.

5B.24.10 City of McGregor

5B.24.10.1 Description of Supply

The City of McGregor obtains its water supply from the Trinity Aquifer and from surface water from Lake Belton. The City owns and operates three wells and purchases water from Lake Belton through Bluebonnet WSC. The City of McGregor has also contracted with the City of Waco for supplemental surface water supply from Lake Waco. The City of McGregor has contracted for adequate supply of raw water from Lake Belton, however, the surface water supply is limited by the infrastructure capacity to deliver water from Lake Belton to the City of McGregor.

5B.24.10.2 Options Considered

The City of McGregor has a shortage of 313 acft per year in 2030, which is about 28 percent of demand. Table 5B.24-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of McGregor shortage.

Table 5B.24-2.
Water Management Strategies Considered for the City of McGregor

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	56	$32,402/year	$574[2]
Infrastructure Capacity Expansion	360	$103,000[3]	$28[3]
No Action	-	$10,949,000*	$46,394*

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: New estimate infrastructure expansion.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.24.10.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages through 2050 of the City of McGregor:

- Infrastructure expansion to supply an additional 360 acft/yr. Expansion includes a pump station expansion.

5B.24.10.4 Costs

Costs of the recommended plan for the City of McGregor to meet 2050 shortages are:

a. Infrastructure expansion:
   - Cost Source: New cost estimate for infrastructure expansion
   - Date to be Implemented: By 2005
   - Total Project Cost: $103,000

- Annual Cost: $10,000

  The Cost Estimate includes a 1,000 gpm pump station expansion.

Table 5B.24-3.
Recommended Plan Costs by Decade for the City of McGregor

Plan Element	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Infrastructure Expansion						
Projected Shortage (acft/yr)	(273)	(308)	(290)	(313)	(329)	(360)
Supply From Plan Element (acft/yr)	-	308	290	313	329	360
Annual Cost ($/yr)	-	$10,000	$10,000	$10,000	$2,000	$2,000
Unit Cost ($/acft)	-	$32	$34	$32	$6	$6

5B.24.11 City of Moody

The City of Moody obtains its water supply from groundwater from the Trinity Aquifer and from surface water from Lake Belton. The city owns and operates one well and purchases surface water from Lake Belton through Bluebonnet WSC. No shortages are projected for the City of Moody and no changes in water supply are recommended.

5B.24.12 City of Northcrest

The City of Northcrest obtains its water supply from groundwater from the Trinity Aquifer and from surface water from the City of Waco. No shortages are projected for the City of Northcrest and no changes in water supply are recommended.

5B.24.13 City of Riesel

The City of Riesel obtains its water supply from groundwater from the Trinity Aquifer through RMS WSC. No shortages are projected for the City of Riesel and no changes in water supply are recommended.

5B.24.14 City of Robinson

The City of Robinson obtains its water supply from groundwater from the Trinity Aquifer and from surface water from the Brazos River. The City owns and operates six wells and diverts and treats water from the Brazos River utilizing water rights acquired by the City. The City has constructed a portion of the total waters supply project that is permitted from the Brazos River and the current surface water supply is limited by the infrastructure capacity to store water to provide sufficient firm yield.

5B.24.14.2 Options Considered

The City of Robinson has a shortage of 551 acft per year in 2030, which is about 45 percent of demand. Table 5B.24-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Robinson shortage.

Table 5B.24-4.
Water Management Strategies Considered for the City of Robinson

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	61	$35,000/year	$574[2]
Infrastructure Capacity Expansion	615	$3,421,000	$405[3]
No Action	-	N/A*	N/A*

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: New estimate infrastructure expansion.
* Economic impact of not meeting shortage (i.e., "no action" alternative) not available.

5B.24.14.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages through 2050 of the City of Robinson:

- Infrastructure expansion to supply an additional 615 acft/yr. Expansion includes additional off-channel reservoir storage.

5B.24.14.4 Costs

Costs of the recommended plan for the City of Robinson to meet 2050 shortages are:

a. Infrastructure expansion:
   - Cost Source: New cost estimate for infrastructure expansion
   - Date to be Implemented: By 2005
   - Total Project Cost: $3,421,000

- Annual Cost: $249,000

Table 5B.24-5.
Recommended Plan Costs by Decade for the City of Robinson

Plan Element	2000	2010	2020	2030	2040	2050
Infrastructure Expansion						
Projected Shortage (acft/yr)	(481)	(526)	(517)	(551)	(571)	(615)
Supply From Plan Element (acft/yr)	-	615	615	615	615	615
Annual Cost ($/yr)	-	$254,000	$254,000	$254,000	$5,000	$5,000
Unit Cost ($/acft)	-	$413	$413	$413	$8	$8

5B.24.15 City of Valley Mills

The City of Valley Mills obtains its water supply from groundwater from the Trinity Aquifer. The City lies primarily in Bosque County and a plan for water supply is included in the Bosque County section of this report.

5B.24.16 City of Waco

The City of Waco obtains its water supply from surface water from Lake Waco. The City of Waco owns water rights for Lake Waco and is participating in a project with the Brazos River Authority to enlarge the lake. The City supplies several neighboring communities and has sufficient water supply to meet its needs and the regional needs. No shortages are projected for the City of Waco and no changes in water supply are recommended.

5B.24.17 City of West

The City of West obtains its water supply from groundwater from the Trinity Aquifer. The City owns and operates four wells that serve as the City's primary supply. The City is considering an interconnection with the City of Waco for a supplemental supply.

5B.24.17.2 Options Considered

The City of West has a shortage of 399 acft per year in 2030. Table 5B.24-6 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of West shortage.

Table 5B.24-6.
Water Management Strategies Considered for the City of West

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	23	$13,000/year	$574[2]
Infrastructure Capacity Expansion – City of Waco Interconnection	451	$560,000[3]	$740[3]
No Action	-	N/A*	N/A*

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: New estimate infrastructure expansion.
* Economic impact of not meeting shortage (i.e., "no action" alternative) not available.

5B.24.17.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages through 2050 of the City of West:

- Infrastructure expansion to supply an additional 451 acft/yr. Expansion includes a 6-inch pipeline to interconnect to the City of Waco.

5B.24.17.4 Costs

Costs of the recommended plan for the City of West to meet 2050 shortages are:

a. Infrastructure expansion:
   - Cost Source: New cost estimate for infrastructure expansion
   - Date to be Implemented: By 2005
   - Total Project Cost: $560,000
   - Annual Cost: $334,000

   The Cost Estimate includes 7.5 miles of 6-inch pipeline and purchase of treated water from the City of Waco at $650 per acft.

Table 5B.24-7.
Recommended Plan Costs by Decade for the City of West

Plan Element	2000	2010	2020	2030	2040	2050
Infrastructure Expansion						
Projected Shortage (acft/yr)	(469)	(451)	(419)	(399)	(385)	(378)
Supply From Plan Element (acft/yr)	-	451	451	451	451	451
Annual Cost ($/yr)	-	$334,000	$334,000	$334,000	$292,000	$292,000
Unit Cost ($/acft)	-	$740	$740	$740	$647	$647

5B.24.18 City of Woodway

The City of Woodway obtains its water supply from groundwater from the Trinity Aquifer and from surface water from Lake Belton. The City owns and operates six wells and purchases treated water from Lake Belton from the Bluebonnet WSC. The City of Woodway has also contracted with the City of Waco for supplemental surface water supply from Lake Waco. No shortage is projected for the City of Woodway and no changes in water supply are recommended.

5B.24.19 County-Other

5B.24.19.1 Description of Supply

McLennan County-Other obtains its water supply from groundwater from the Trinity Aquifer and from surface water supplied from the City of Waco to rural water supply corporations. A shortage of 4,029 acft is projected for County-Other in the year 2030.

5B.24.19.2 Options Considered

McLennan County-Other has a shortage of 4,029 acft per year in 2030. Table 5B.24-8 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the McLennan County-Other shortage.

Table 5B.24-8.
Water Management Strategies Considered for County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	298	$171,000/year	$574[2]
Water Supply from City of Waco	4,029	$2,724,000[3]	$736[3]
No Action	-	$17,158,000[4]	$18,080[4]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: New estimate for transmission line expansion.
4 Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.24.19.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages through 2050 of County-Other:

- Water supply from City of Waco.

5B.24.19.4 Costs

Costs of the recommended plan for County–Other to meet 2050 shortages are:

a. Water supply from City of Waco:
   - Cost Source: New Cost Estimate for Infrastructure Expansion
   - Date to be Implemented: By Year 2005
   - Total Project Cost: $2,724,000
   - Annual Cost: $962,000

   The Cost Estimate includes 6-miles of 10-inch diameter pipeline, a pump station, and the cost of purchasing the water at a wholesale water rate of $650 per acft.

Table 5B.24-9.
Recommended Plan Costs by Decade for County-Other

Plan Element	2000	2010	2020	2030	2040	2050
Water Supply From City of Waco						
Projected Shortage (acft/yr)	(3,441)	(3,480)	(3,465)	(4,029)	(3,912)	(3,785)
Supply From Plan Element (acft/yr)	-	4,029	4,029	4,029	4,029	4,029
Annual Cost ($/yr)	-	$2,964,000	$2,964,000	$2,964,000	$2,717,000	$2,717,000
Unit Cost ($/acft)	-	$736	$736	$736	$674	$674

5B.24.20 Manufacturing

5B.24.20.1 Description of Supply

Water supply for Manufacturing in McLennan County is obtained by purchase from a city or water supply corporation or from private wells operated by the Manufacturing entity. Each of the cities and the rural area outside of the cities in McLennan County has the ability to supply the Manufacturing demand from surplus supplies available in the county. Although Manufacturing demand is shown to have a current shortage and through the year 2050, existing municipal supplies are and will continue to supply the needs of Manufacturing through the planning period, with surplus supplies from the City of Waco expected to provide the largest quantity of supply.

5B.24.20.2 Options Considered

McLennan County Manufacturing has a shortage of 4,384 acft per year in 2030. Table 5B.24-10 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the McLennan County Manufacturing shortage.

Table 5B.24-10.
Water Management Strategies Considered for Manufacturing

Option	Yield (acft/yr)	Approximate Cost[1] Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	221	$127,000/year	$574[2]
Wastewater Reuse	3,462	$13,991,000	$326[3]
Water Supply from City of Waco	19,914	$2,858,000/year	$652[4]
No Action	-	$260,364,000*	$123,806*

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Unit Cost of Wastewater Reuse.
[4] Source of Cost Estimate: Estimated wholesale purchase price from the City of Waco.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.24.20.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages through 2050 of Manufacturing:

- Water supply from City of Waco.

5B.24.20.4 Costs

Costs of the recommended plan for Manufacturing to meet 2050 shortages are:

a. Water supply from City of Waco:
   - Cost Source: Estimated wholesale purchase price for treated City of Waco water
   - Date to be Implemented: By Year 2005
   - Annual Cost: $2,858,000

Table 5B.24-11.
Recommended Plan Costs by Decade for McLennan County Manufacturing

Plan Element	2000	2010	2020	2030	2040	2050
Water Supply From City of Waco						
Projected Shortage (acft/yr)	(3,071)	(3,518)	(3,950)	(4,384)	(4,932)	(5,617)
Supply From Plan Element (acft/yr)	-	4,384	4,384	4,384	5,617	5,617
Annual Cost ($/yr)	-	$2,858,000	$2,858,000	$2,858,000	$3,662,000	$3,662,000
Unit Cost ($/acft)	-	$652	$652	$652	$652	$652

5B.24.21 Steam-Electric

Steam-Electric demand in McLennan County is associated with the Lake Creek and Tradinghouse Creek Power Plants owned and operated by Texas Utilities Company (TXU). The Lake Creek Power Plant is supplied by water from Lake Creek Reservoir that impounds runoff from the small upstream watershed and diversions from the Brazos River. Tradinghouse Creek Power Plant is supplied by water from Tradinghouse Creek Reservoir that impounds runoff from the Tradinghouse Creek watershed and also from diversions from the Brazos River. In addition to existing water rights on the Brazos River associated with each of the two projects, TXU has also contracted with the Brazos River Authority for water supply from the BRA System. No shortages are projected for Steam-Electric demands in McLennan County and no changes in water supply are recommended.

5B.24.22 Mining

5B.24.22.1 Description of Supply

Mining obtains its water supply from various sources including groundwater and surface water. There are sufficient supplies in McLennan County to meet Mining demands from the county-wide surplus.

5B.24.22.2 Options Considered

McLennan County Mining has a shortage of 1,071 acft per year in 2030, which is 100 percent of demand. Table 5B.24-12 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the McLennan County Mining shortage.

Table 5B.24-12.
Water Management Strategies Considered for McLennan County Mining

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Water Supply from City of Waco	19,914	$862,000/year	$652[2]
No Action	-	$3,506,000*	$3,273*

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Estimated wholesale purchase price from the City of Waco.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.24.22.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected shortages through 2050 of Mining:

- Water supply from City of Waco.

5B.24.22.4 Costs

Costs of the recommended plan for Mining to meet 2050 shortages are:

a. Water supply from City of Waco:
   - Cost Source: Estimated wholesale purchase price for treated City of Waco water
   - Date to be Implemented: By Year 2005
   - Annual Cost: $862,000

Table 5B.24-13.
Recommended Plan Costs by Decade for Mining

Plan Element	2000	2010	2020	2030	2040	2050
Water Supply From City of Waco						
Projected Shortage (acft/yr)	(750)	(833)	(952)	(1,071)	(1,190)	(1,322)
Supply From Plan Element (acft/yr)	-	1,071	1,071	1,071	1,322	1,322
Annual Cost ($/yr)	-	$862,000	$862,000	$862,000	$862,000	$862,000
Unit Cost ($/acft)	-	$652	$652	$652	$652	$652

5B.24.23 Irrigation

No shortage is projected for McLennan County Irrigation and no changes in water supply are recommended. Additional supply may be available for Irrigation use through implementation of the Big Creek Watershed Project.

5B.24.24 Livestock

No shortage is projected for McLennan County Livestock and no changes in water supply are recommended. Additional supply may be available for Livestock use through implementation of the Big Creek Watershed Project.

5B.25 Milam County Water Supply Plan

Table 5B.25-1 lists each water user group in Milam County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections.

Table 5B.25-1.
Milam County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Cameron	1,321	1,295	Projected surplus
City of Rockdale	178	(30)	Projected shortage – see plan below
City of Thorndale	197	194	Projected surplus
County-Other	1,998	2,013	Projected surplus
Manufacturing	9,739	8,189	Projected surplus
Steam-Electric	(3,498)	(6,998)	Projected shortage – see plan below
Mining	0	0	No Projected Needs
Irrigation	8,941	8,964	Projected surplus
Livestock	1,627	1,627	Projected surplus

[1] From Tables 4-49 and 4-50, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.25.1 City of Cameron

No shortage is projected for the City of Cameron and no changes in water supply are recommended.

5B.25.2 City of Rockdale

5B.25.2.1 Description of Supply

Source: Simsboro Aquifer

Estimated Reliable Supply: 2,121 acft/yr

System Description: 6 wells

The City of Rockdale's groundwater supply is limited by well capacity.

5B.25.2.2 Options Considered

The City of Rockdale has a shortage of 30 acft per year in 2050, which is about 1 percent of demand. Table 5B.25-2 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for meeting the City of Rockdale shortage.

Table 5B.25-2.
Water Management Strategies Considered for the City of Rockdale

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	215	$103,000/year	$4,574
Further Development of Carrizo-Wilcox Aquifer	300	$250,000[2]	$4,214[2]
No Action	-	$1,392,000[3]	$46,394[3]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: (1) 200 gpm capacity well at 400' depth with 0.5 miles of 6" pipe.
3 Economic impact of not meeting shortage (i.e., "no action") in 2050 as estimated by TWDB.

5B.25.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage of the City of Rockdale:

- Further development of Carrizo-Wilcox Aquifer

5B.25.2.3 Costs

Costs of the Recommended Plan for the City of Rockdale.

- Cost Source: New Cost estimate for additional well
- Date to be Implemented: 2030
- Total Project Cost: $250,000

Table 5B.25-3.
Recommended Plan Costs by Decade for the City of Rockdale

Plan Element	2000	2010	2020	2030	2040	2050
Additional Well						
Projected Surplus/(Shortage) (acft/yr)	391	318	279	178	86	(30)
Supply From Plan Element (acft/yr)	-	-	-	300	300	300
Annual Cost ($/yr)	-	-	-	$19,000	$19,000	$19,000
Unit Cost ($/acft)	-	-	-	$64	$64	$64

5B.25.3 City of Thorndale

No shortage is projected for the City of Thorndale and no changes in water supply are recommended.

5B.25.4 County-Other

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.25.5 Manufacturing

The water supply entities for Manufacturing show a projected surplus and no changes in water supply are recommended.

5B.25.6 Steam-Electric

5B.25.6.1 Description of Supply

Alcoa Steam-Electric surface water supply is limited due to expiring BRA contract from Lake Granger in 2019.

5B.25.6.2 Options Considered

Milam County Steam-Electric has a shortage of 3,498 acft per year in 2030, which is about 28 percent of demand. Table 5B.25-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the Milam County Steam-Electric shortage.

Table 5B.25-4.
Water Management Strategies Considered for Milam County Steam-Electric

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Alcoa Renewal of BRA Contract (Raw Water)	5,000	$115,000/year	$23[2]
Reallocation of Manufacturing Groundwater Supply	2,000	[3]	[3]
No Action	-	$16,446,000*	$4,701*

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: BRA System Rate.
[3] Infrastructure needed to implement this option is not known.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.25.6.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of Milam County's Steam-Electric supply:

- Alcoa renewal of BRA raw water contract

For the long-term period beyond 2030, the following additional water management strategies are recommended:

- Alcoa renewal of BRA raw water contract
- Reallocation of manufacturing groundwater supply to Steam-Electric

5B.25.6.4 Costs

Costs of the Recommended Plan for Steam-Electric shortage:

- Cost Source: BRA System Rate
- Date to be Implemented: By Year 2020
- Total Project Cost: $115,000/year

Table 5B.25-5.
Recommended Plan Costs by Decade for Milam County Steam-Electric

Plan Element	2000	2010	2020	2030	2040	2050
Renewal of BRA raw water contract						
Projected Surplus/(Shortage) (acft/yr)	322	322	(3,498)	(3,498)	(3,498)	(6,998)
Supply from Plan Elements (acft/yr)	-	-	5,000	5,000	5,000	5,000
Annual Cost ($/yr)	-	-	$115,000	$115,000	$115,000	$115,000
Unit Cost ($/acft)	-	-	$23	$23	$23	$23

5B.25.7 Mining

Projected Mining demand in Milam County is primarily associated with Alcoa and their lignite mining operation. The operation includes depressurization of the groundwater in the layer below the underground lignite formation in order to extract the lignite resource. The water supply available is essentially the amount of water that is produced in the depressurization operation. This operation is largely non-consumptive and the water produced is available for other uses. The San Antonio Water System (SAWS), located in the South Central Texas Region (L), has contracted to purchase Carrizo-Wilcox Aquifer groundwater produced from land owned or leased by Alcoa in Milam, Lee, and Bastrop Counties. The Region L water plan calls for 55,000 acft/yr to be purchased through this contract. Water to be sold by Alcoa originates primarily from their ongoing lignite mining activities. Table 4-49A reports water quantities to be delivered from Milam County to SAWS consistent with the water plan being prepared by the South Central Texas Region RWPG. No shortages for Mining use are projected through the year 2050.

5B.25.8 Irrigation

No shortage is projected for the Milam County's Irrigation and no changes in water supply are recommended.

5B.25.9 Livestock

No shortage is projected for the Milam County's Livestock and no changes in water supply are recommended.

5B.26 Nolan County Water Supply Plan

Table 5B.26-1 lists each water user group in Nolan County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Nolan County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plan described below either includes specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.26-1.
Nolan County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Roscoe	612	620	Projected surplus
City of Sweetwater	2,325	3,039	Projected surplus – see plan below
County-Other	(155)	(89)	Projected shortage – see plan below
Manufacturing	(697)	(835)	Projected shortage – see plan below
Steam-Electric	0	0	No demand or supply
Mining	32	34	Projected surplus
Irrigation	141	229	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-51 and 4-52, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.26.1 The City of Roscoe

5B.26.1.1 Description of Supply

The City of Roscoe obtains surface water from local sources and groundwater from the Dockum and Edwards-Trinity (Plateau) aquifers. No current or future shortages are projected. Therefore, no change in water supply uses are projected or recommended.

5B.26.2 The City of Sweetwater

5B.26.2.1 Description of Supply

The City of Sweetwater receives surface water from Lake Sweetwater, Lake Trammell, and Oak Creek Reservoir, along with groundwater from the Dockum and Edwards-Trinity (Plateau) aquifers. A water supply plan was developed due to the fact that if all existing contracts are renewed and the manufacturing deficit is covered as recommended, the city will have projected shortages. In addition, the city has emphasized that it prefers it's planning to be done with safe yield rather than firm yield. If this is done and all existing contracts are renewed, then the city's projected deficit would be 1,778 acft/yr in 2030.

5B.26.2.2 Options Considered

Table 5B.26-2 lists the water management strategies, reports section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Sweetwater's shortages.

Table 5B.26-2.
Water Management Strategies Considered for the City of Sweetwater

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
Wastewater reuse (Section 5A.3)	900	$5,100,000	$500
Diversion to Lake Sweetwater (Section 5A.7.3)	790	$3,000,000	$400
Champion Well Field(2)	2,200	$6,400,000	$400
Voluntary redistribution from Lake Alan Henry	2,000	$4,500,000/yr	$2,250
No Action	-	*	*

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
2 Has water quality concerns, will require additional treatment.
* Under firm yield conditions, no shortage exists.

5B.26.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Sweetwater:

- Wastewater reuse
- Diversion to Lake Sweetwater
- Champion Well Field

5B.26.2.4 Costs

Costs of the Recommended Plan for the City of Sweetwater.

a. Wastewater reuse:
   - Cost Source: Wastewater Reuse Feasibility Study, prepared for TWDB and City of Sweetwater by Freese and Nichols, 1993.
   - Date to be Implemented: before 2010
   - Total Project Cost: $5,100,000
   - Total Annual Cost: $500/acft

b. Additional Conservation
   - Cost Source: Section 5A.2
   - Date to be Implemented: before 2010
   - Total Project Cost: $224,000/yr
   - Total Annual Cost: $574/acft

c. Diversion to Lake Sweetwater
   - Cost Source: Section 5A.7.3
   - Date to be Implemented: before 2040
   - Total Project Cost: $3,000,000
   - Total Annual Cost: $400/acft

d. Champion Well Field
   - Cost Source: *Champion Well Field Collection and Transmission Study*, Freese and Nichols, 1988.
   - Date to be Implemented: before 2010
   - Total Project Cost: $6,700,000
   - Total Unit Cost: $230/acft

5B.26.3 County-Other Category

5B.26.3.1 Description of Supply

County-Other water supply is limited after 2010 by expiring contracts with the City of Sweetwater. Groundwater sources are the Dockum and Edwards-Trinity (Plateau) aquifers.

5B.26.3.2 Options Considered

Table 5B.26-4 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the County-Other category.

Table 5B.26-3.
Recommended Plan Costs by Decade for City of Sweetwater

Plan Element	2000	2010	2020	2030	2040	2050
Projected Surplus/(Shortage) (acft/yr) (1)	(1,798)	(1,826)	(1,817)	(1,778)	(1,721)	(1,723)
Wastewater Reuse						
Supply From Plan Element (acft/yr)	0	900	900	900	900	900
Annual Cost ($/yr)	$0	$450,000	$450,000	$450,000	$42,000	$42,000
Unit Cost ($/acft)	$0	$500	$500	$500	$47	$47
Conservation						
Supply From Plan Element (acft/yr)	0	390	390	390	390	390
Annual Cost ($/yr)	$0	$224,000	$224,000	$224,000	$224,000	$224,000
Unit Cost ($/acft)	$0	$574	$574	$574	$574	$574
Champion Well Field						
Supply From Plan Element (acft/yr)	0	4,000	4,000	4,000	4,000	4,000
Annual Cost ($/yr)	$0	$920,000	$920,000	$920,000	$180,000	$180,000
Unit Cost ($/acft)	$0	$230	$230	$230	$45	$45
Diversion to Lake Sweetwater						
Supply From Plan Element (acft/yr)	0	0	0	0	790	790
Annual Cost ($/yr)	$0	$0	$0	$0	$79,000	$79,000
Unit Cost ($/acft)	$0	$0	$0	$0	$400	$400
Total New Supply (acft/yr)	0	5,290	5,290	5,290	6,080	6,080

[1] Assumes safe yield, extension of all existing contracts, and provisions for manufacturing use deficit.

Table 5B.26-4.
Water Management Strategies Considered for Nolan County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Voluntary Redistribution from Municipal Supply of the City of Sweetwater	155	$100,750/yr	$650 [2]
No Action	-	$2,802,000*	$18,080*

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.

[2] Estimated wholesale rate of treated water.

* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.26.3.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the County-Other category:

- Voluntary Redistribution from Municipal Supply of the City of Sweetwater

5B.26.3.4 Costs

Costs of the recommended plan for County-Other to meet 2030 shortages are:

a. Voluntary Redistribution from Municipal Supply of the City of Sweetwater:

- Estimated wholesale rate of $650/acft for treated water
- Date to be Implemented: In place
- Total Annual Cost: $100,750

5B.26.4 Manufacturing

5B.26.4.1 Description of Supply

The current water supply for Manufacturing consists of 50 acft/yr of groundwater, leaving large shortages.

5B.26.4.2 Options Considered

Table 5B.26-5 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the Manufacturing category's shortages.

Table 5B.26-5.
Water Management Strategies Considered for Nolan County Manufacturing

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Voluntary redistribution from Municipal Supply	697	$453,000/yr	$650
No Action	-	$140,924,000*	$202,187*

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.26.4.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Manufacturing category:

- Voluntary redistribution from Municipal Supply

5B.26.4.4 Costs

Costs of the Recommended Plan for Manufacturing:

a. Voluntary redistribution from Municipal Supply:

- Cost Source: Estimated wholesale rate of $650/acft for treated water
- Date to be Implemented: In place
- Total Annual Cost: $453,000

5B.26.5 Steam-Electric

The water supply entities for Steam-Electric show a projected surplus and no changes in water supply are recommended.

5B.26.6 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.26.7 Irrigation

No shortages are projected for Irrigation and no changes in water supply are recommended.

5B.26.8 Livestock

No shortages are projected for Livestock and no changes in water supply are recommended.

5B.27 Palo Pinto County Water Supply Plan

Table 5B.27-1 lists each water user group in Palo Pinto County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses.

Table 5B.27-1.
Palo Pinto County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Graford	93	6	Projected surplus
City of Mineral Wells	3,905	3,798	Projected surplus
City of Palo Pinto	(82)	(83)	Projected shortage – see plan below
City of Strawn	85	94	Projected surplus
County-Other	1,172	1,020	Projected surplus
Manufacturing	(86)	(118)	Projected shortage – see plan below
Steam-Electric	66,034	46,034	Projected surplus
Mining	6,093	6,093	Projected surplus
Irrigation	2,969	2,980	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-53 and 4-54, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.27.1 City of Graford

The City of Graford obtains surface water from Keechi Creek and purchases water from Palo Pinto MWD No 1. No shortages are projected and no changes in water supply are recommended.

5B.27.2 City of Mineral Wells

The City of Mineral Wells obtains surface water from Lake Palo Pinto from a contract with the Palo Pinto Municipal Water District No. 1 (District). The District owns Lake Palo Pinto on Palo Pinto Creek as well as a water treatment plant. The District sells raw industrial water to Brazos Electric Power Cooperative and raw municipal water to the Lake Palo Pinto WSC, which is the water supply system for the area around Lake Palo Pinto. Under a contract with the City of Mineral Wells, the City operates the District's filter plant and delivers treated water to Mineral Wells as well as the City of Graford and six rural water supply corporations. One of the water supply corporations sells water to the City of Palo Pinto. The District is concerned that Lake Palo Pinto may not be an adequate supply source for anticipated needs of all of its customers. Consequently, the District initiated planning studies of an additional reservoir on Palo Pinto Creek known as the Turkey Peak Dam and Reservoir. Construction of Turkey Peak Dam and Reservoir would result in significantly greater water availability to the area. Because this water source has not yet been evaluated under SB 1 criteria nor considered by the Brazos G RWPG, it is recommended that it be included for study in the next SB 1 planning cycle.

5B.27.3 City of Palo Pinto

5B.27.3.1 Description of Supply

The City of Palo Pinto surface water supply is limited due to expiring contract with the City of Mineral Wells in 2007. The City has a projected shortage of 82 acft in 2030, which is 100 percent of the City's demand.

5B.27.3.2 Options Considered

Table 5B.27-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Palo Pinto's shortage.

5B.27.3.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage of the City of Palo Pinto:

- Extend existing contract with Mineral Wells

Palo Pinto MWD No. 1 has conducted planning studies of the Turkey Peak Dam and Reservoir on Palo Pinto Creek. This project would provide a significantly greater water supply to the District and possibly to the City of Palo Pinto. Because this water source has not yet been evaluated under SB 1 criteria nor considered by the Brazos G RWPG, it is recommended that it be included for study in the next SB 1 planning cycle.

Table 5B.27-2.
Water Management Strategies Considered for the City of Palo Pinto

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Extend existing contract with Mineral Wells	179	$116,000	$650[2]
Wastewater Reuse (Section 5A.3)	5	$20,192	$326
Additional Water Conservation (Section 5A.2)	4	$2,300/yr	$574
South Bend Reservoir (Section 5A.14.2)	106,700	$241,761,000	$173[3]
No Action	-	$3,480,341[4]	$42,443[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Estimated wholesale cost of treated water from the City of Mineral Wells.
[3] Raw water supply only. Does not include costs for treatment and delivery.
[4] Economic impact of not meeting shortage (i.e., “no action”) in 2030 as estimated by TWDB.

The South Bend Reservoir has been recommended for consideration for long-term needs for the Brazos River Authority, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality; however, if the BRA pursues it, this source should be considered by local entities.

5B.27.3.4 Costs

Costs of the recommended plan for the City of Palo Pinto to meet 2030 shortages are:

a. Extension of existing contract with Mineral Wells:
   - Cost Source: Estimated wholesale treated water cost of $650/acft
   - Date to be Implemented: 2007
   - Total Annual Cost: $53,000

5B.27.4 The City of Strawn

The City of Strawn obtains surface water from Lake Tucker. No future shortages are projected and no changes in water supply are projected.

Table 5B.27-3.
Recommended Plan Costs by Decade for City of Palo Pinto

	2000	2010	2020	2030	2040	2050
Projected shortage[1] (acft/yr)	0	85	82	82	82	83
Supply from Plan Elements (acft/yr)	0	179	179	179	179	179
Annual Costs ($/yr)	0	$116,000	$116,000	$116,000	$116,000	$116,000
Unit costs ($/acft)	0	$650	$650	$650	$650	$650

5B.27.5 County-Other

Although no shortages are projected, County-Other surface water supply is affected by expiring contracts with the City of Mineral Wells. Consideration should be given by each of the water purchasing entities and by the City of Mineral Wells to extend current water supply contracts through the planning period. County-Other entities also rely on the Trinity Aquifer for groundwater. No future shortages are projected and no changes in water supply are recommended.

Palo Pinto MWD No. 1, through the City of Mineral Wells, supplies six water supply corporations in Palo Pinto County. The District has conducted planning studies of a possible new source of water known as the Turkey Peak Dam and Reservoir on Palo Pinto Creek. This project would provide a significantly greater water supply to the District and possibly to other entities in the county. Because this water source has not yet been evaluated under SB 1 criteria nor considered by the Brazos G RWPG, it is recommended that it be included for study in the next SB 1 planning cycle.

5B.27.6 Manufacturing

5B.27.6.1 Description of Supply

Manufacturing supplies are obtained from local surface water sources and groundwater from the Trinity Aquifer. Manufacturing industries have a projected shortage of 86 acft in 2030, which is about 92 percent of demand.

5B.27.6.1 Options Considered

Table 5B.27-5 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting Manufacturing's shortage.

Table 5B.27-4.
Water Management Strategies Considered for Palo Pinto County Manufacturing

Option	*Yield (acft/yr)*	*Approximate Cost*	
		Total	*Unit ($/acft)*
Voluntary redistribution from Municipal Supply	120	$78,000/yr	$650[1]
South Bend Reservoir (Section 5A.14.2)	106,700	$241,761,000	$173
No Action	-	$18,686,000[2]	$217,275[2]

[1] Estimated cost for treated water from municipal source in Palo Pinto County.
[2] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.27.6.1 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage of the Manufacturing category:

- Voluntary redistribution from appropriate Municipal supply

The South Bend Reservoir has been recommended for consideration for long-term needs for the Brazos River Authority, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the BRA, this source should be considered by local entities.

5B.27.6.1 Costs

Costs of the recommended plan for Manufacturing to meet 2050 shortages are:

a. Voluntary redistribution from Municipal supply:
   - No modifications to existing system needed
   - Date to be Implemented: 2010
   - Total Annual Cost: $78,000 per year

5B.27.7 Steam-Electric

Steam-Electric demand in Palo Pinto County is associated with the R.W. Miller Steam-Electric Station, owned and operated by the Brazos Electric Coop. Water supply for the R.W. Miller Plant is obtained from Lake Palo Pinto through a contract with Palo Pinto Municipal Water District No. 1. No future shortages are projected and no changes in water supply are recommended.

5B.27.8 Mining

No future shortages are projected and no changes in water supply are recommended.

5B.27.9 Irrigation

No future shortages are projected and no changes in water supply are recommended.

5B.27.10 Livestock

No future shortages are projected and no changes in water supply are recommended.

5B.28 Robertson County Water Supply Plan

Table 5B.28-1 lists each water user group in Robertson County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.28-1.
Robertson County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Bremond	227	207	Projected surplus
City of Calvert	234	164	Projected surplus
City of Franklin	383	343	Projected surplus
City of Hearne	(67)	(290)	Projected shortage – see plan below
County-Other	1,724	1,725	Projected surplus
Wheelock WSC [2]	(*)	(*)	See footnote [2]
Manufacturing	206	180	Projected surplus
Steam-Electric	10,727	10,727	Projected surplus
Mining	82	82	Projected surplus
Irrigation	28,313	29,413	Projected surplus
Livestock	474	474	Projected surplus

[1] From Tables 4-57 and 4-56, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.
[2] Although no county-wide shortages are projected, Wheelock WSC has indicated the need for near-term projects to meet expected local shortages.

5B.28.1 City of Bremond

The City of Bremond obtains its water supply from groundwater from the Carrizo-Wilcox Aquifer. The city owns and operates five wells that are projected to supply the needs of the City of Bremond through the year 2050. No shortages are projected for the City of Bremond and no changes in water supply are recommended.

5B.28.2 City of Calvert

The City of Calvert obtains its water supply from groundwater from the Carrizo-Wilcox Aquifer. The City owns and operates three wells that are projected to supply the needs of the City of Calvert through the year 2050. No shortages are projected for the City of Calvert and no changes in water supply are recommended.

5B.28.3 City of Franklin

The City of Franklin obtains its water supply from groundwater from the Carrizo-Wilcox Aquifer. The City owns and operates three wells that are projected to supply the needs of the City of Franklin through the year 2050. No shortages are projected for the City of Franklin and no changes in water supply are recommended.

5B.28.4 City of Hearne

5B.28.4.1 Description of Supply

The City of Hearne obtains its water supply from groundwater from the Carrizo-Wilcox Aquifer. The City owns and operates four wells that produce water from the aquifer that serves as the City's sole source supply. The water supply available from the Carrizo-Wilcox Aquifer is sufficient to meet the City's demands, however, the City's ability to meet demands in the year 2030 is projected to be constrained by the capacity of the existing wells.

5B.28.4.2 Options Considered

The City of Hearne has a shortage of 67 acft per year in 2030, which is about 4 percent of demand. Table 5B.28-2 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for meeting the City of Hearne shortage.

Table 5B.28-2.
Water Management Strategies Considered for the City of Hearne

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation – City of Hearne (Section 5A.2)	75	$43,000/yr[2]	$574[2]
Further development of Carrizo-Wilcox Aquifer	290	$609,000[3]	$231[3]
No Action	-	$3,108,000[3]	$46,394[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: New estimate for addition of municipal supply well to existing system.
[4] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.28.4.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected year 2030 and 2050 shortage of the City of Hearne:

- Construct a new municipal supply well by 2030 to supply an additional 290 acft per year.

5B.28.4.4 Costs

Costs of the Recommended Plan for the City of Hearne:

- Cost Source: New estimate for municipal supply well
- Date to be Implemented: 2030
- Total Project Cost: $609,000

  The cost estimate includes 1,000 feet of 8-inch diameter pipeline and the construction of a 360 gpm, 1,500-feet deep well.

Table 5B.28-3.
Recommended Plan Costs by Decade for the City of Hearne

Plan Element	2000	2010	2020	2030	2040	2050
New Municipal Well						
Projected Shortage (acft/yr)	0	0	0	(67)	(165)	(290)
Supply From Plan Element (acft/yr)	0	0	0	290	290	290
Annual Cost ($/yr)	0	0	0	$49,000	$58,000	$67,000
Unit Cost ($/acft)	0	0	0	$731	$351	$231

5B.28.5 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no basic changes in water supply are recommended. Despite the county-wide projections of surplus water, the Wheelock WSC has indicated that near-term projects will be needed to meet expected local shortages.

5B.28.5.1 Description of Supply (Wheelock WSC)

The Wheelock WSC currently obtains its water supply from local groundwater sources.

5B.28.5.2 Water Supply Plan

In anticipation of possible future shortages, the Wheelock WSC is merging with the Wickson Creek Special Utility District (Wickson), based in adjacent Brazos County. Wickson has developed a capital plan to meet future needs in Robertson County currently served by Wheelock WSC. A pipeline will be constructed to transport 175 acre-feet of water per year, and the Sparta Aquifer will be further developed to meet the needs of the Wheelock WSC.

5B.28.5.3 Costs

It is anticipated that all project costs (debt service, water purchase, and O&M) for the Wheelock/Wickson system expansion and merger will be borne by collection of utility fees. Based on projected water rates for Wheelock/Wickson of $2.50 per 1,000 gallons, the unit cost for water obtained through this option will be $815 per acre-foot.

Table 5B.28-4
Water Management Strategies Considered for Wheelock WSC

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Merge with Wickson Creek SUD	(*) [2]	$500,000 [3]	$815 [4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/ac-ft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Yield will be sufficient to meet unquantified local shortages in Wheelock WSC.
[3] Total Project Cost Estimate based on Wickson SUD's capital improvements plan.
[4] Unit cost based on projected utility rates after Wheelock/Wickson merger.

5B.28.6 Manufacturing

Manufacturing is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.28.7 Steam-Electric

Steam-Electric is projected to have a surplus of water through the year 2050. Steam-Electric water demand in Robertson County is associated with the Twin Oak Power Plant, owned and operated by Texas Utilities Company (TXU), and the TNP One Power Plant, owned and operated by Texas-New Mexico Power Company (TNPC). The Twin Oak Power Plant is supplied by Twin Oak Reservoir. Twin Oak Reservoir impounds runoff from Duck Creek and diversions from the Navasota River. TXU has contracted with the Brazos River Authority for water from Lake Limestone in sufficient quantity to meet its needs through the year 2050. The TNP One Power Plant is supplied by groundwater from the Carrizo-Wilcox Aquifer. The supply from the aquifer is sufficient to meet its need through the year 2050. No changes in water supply are recommended.

5B.28.8 Mining

Mining is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.28.9 Irrigation

Irrigation is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.28.10 Livestock

No shortage is projected for Livestock and no changes in water supply are recommended.

5B.29 Shackelford County Water Supply Plan

Table 5B.29-1 lists each water user group in Shackelford County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Shackelford County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plan described below either includes specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.29-1.
Shackelford County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Albany	1,306	1,387	Projected surplus
County-Other	111	138	Projected surplus
Manufacturing	0	0	No demand or supply
Steam-Electric	0	0	No demand or supply
Mining	(333)	(340)	Projected shortage – see plan below
Irrigation	(179)	(167)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4-57 and 4-58, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.29.1 The City of Albany

Water supply for the City of Albany is from Hubbard Creek Reservoir, owned by the West Central Texas MWD. No future shortages are projected and no changes in water supply are recommended.

5B.29.2 County-Other Category

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.29.3 Manufacturing

No Manufacturing demand exists or is projected for the county.

5B.29.4 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.29.5 Mining

5B.29.5.1 Options Considered

Table 5B.29-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for the Mining category shortage.

Table 5B.29-2.
Water Management Strategies Considered for Shackelford County Mining

Option	*Yield (acft/yr)*	*Approximate Cost*	
		Total	*Unit ($/acft)*
Voluntary Redistribution from Municipal Supply	333	$0	$0
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629
No Action	-	$1,090,000[1]	$3,273[1]

[1] Economic impact of not meeting shortage (i.e., “no action”) in 2030 as estimated by TWDB.

5B.29.5.2 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Mining category:

- Voluntary Redistribution from Municipal Supply.

The Breckenridge Reservoir has been recommended for consideration for long-term needs for the West Central Texas Municipal Water District, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, this source should be considered by local entities.

5B.29.5.3 Costs

Costs of the Recommended Plan for the Mining category to meet 2030 shortages are:

a. Voluntary Redistribution from Municipal Supply:
   - No modifications to existing system needed.
   - Date to be Implemented: In place.
   - Total Project Cost: $0

5B.29.6 Irrigation

5B.29.6.1 Description of Supply

Surface water for Irrigation in Shackelford County is obtained from the Clear Fork of the Brazos River. Estimated reliable supply of surface water for irrigated agriculture is 31acft/yr through the year 2050. There are no significant groundwater supplies available in the county.

5B.29.6.2 Options Considered

Table 5B.29-3 lists the water management strategies that were considered for Shackelford County Irrigation, and references the report section discussing the strategy, total project cost, and unit costs for meeting the shortage.

Table 5B.29-3.
Water Management Strategies Considered for Shackelford County Irrigation

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Irrigation System Conversion [1]	46	$5,474/yr	$119
Brush Control	(*)	(*)	(*)
Weather Modification [2]	(*)	$500,000 to $850,000/yr	(*)
No Action	--	$26,000[3]	$144[3]

[1] Source of Cost Estimate: Texas Agriculture Experiment Station
[2] Source of Cost Estimate: Section 5B.10.
[3] Economic impact of not meeting shortage (i.e., “no action”) in 2030 as estimated by TWDB.
* Definitive yield and/or cost cannot be determined.

5B.29.6.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Irrigation category.

No new water supplies are economically feasible to meet this projected shortage. Water conservation strategies in the form of conversion to irrigation systems with increased efficiency could partially meet the projected shortages. The irrigation systems in Shackelford County are relatively efficient. Options are upgrade of side roll systems to center pivots and possibly some renozzling of older center pivots. Cultural practices such as crop selection, deficit irrigation, and conversion to dryland will account for the remainder of the water conserved (i.e., water not used). Brush control and weather modification may also be used to enhance soil moisture.

As shown in Table 5B.29-4, conservation practices can meet about 46 acft/yr of the projected shortage. Apart from the conservation options presented, it is not economically feasible to meet projected Irrigation shortages listed as unmet demand in Shackelford County.

5B.29.6.4 Costs

Costs of the Recommended Plan for Shackelford County Irrigation supply are outlined in Table 5B.6.3. Costs for some options, such as brush control and weather modification, can not be directly quantified due to lack of specific data. Costs for these options have been estimated based on generally available data outlined in the corresponding chapter in Section 5B. Irrigation system upgrade of 200 of the 300 irrigated acres would provide a maximum of 46 acft/yr at a cost of $119/acft.

5B.29.7 Livestock

No future shortages are projected in the Livestock category and no changes in water supply are recommended.

Table 5B.29-4.
Recommended Plan Costs by Decade for Shackelford County Irrigation[1]

Plan Element	2000	2010	2020	2030	2040	2050
Irrigation System Conversion[2]						
Projected Shortage (acft/yr) [3]	(199)	(192)	(185)	(179)	(173)	(167)
Supply from Plan Element acft/yr)	46	46	46	46	46	46
Annual Cost ($/yr)	$5,474	$5,474	$5,474	$5,474	$5,474	$5,474
Unit Cost ($/acft)	$119	$119	$119	$119	$119	$119
Weather Modification[4]						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Brush Control						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Sum of Supply from Plan Elements (acft/yr)	46	46	46	46	46	46
Unmet Demand [5]	(153)	(146)	(139)	(133)	(127)	(121)

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for water conserved through management practices. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Texas Agriculture Experiment Station.
[3] Total projected irrigation shortages are presented.
[4] Source of Cost Estimate: Section 5B.10.
[5] Apart from the conservation options presented, it is not economically feasible to meet projected irrigation shortages listed as unmet demand in Shackelford County.
* Definitive yield and/or cost estimate cannot be determined.

5B.30 Somervell County Water Supply Plan

Table 5B.30-1 lists each water user group in Somervell County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses.

Table 5B.30-1.
Somervell County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Glen Rose	(300)	(432)	Projected shortage – see plan below
County-Other	(640)	(1,188)	Projected shortage – see plan below
Manufacturing	0	0	No demand or supply
Steam-Electric	0	0	Supply equals demand
Mining	3	(6)	Projected shortage – no plan
Irrigation	522	525	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-59 and 4-60, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.30.1 The City of Glen Rose

5B.30.1.1 Description of Supply

The City of Glen Rose obtains groundwater from the Trinity Aquifer. The City has a projected shortage of 300 acft in 2030, which represents about 44 percent of total demand.

5B.30.1.2 Options Considered

Table 5B.30-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting City of Glen Rose's shortage.

Table 5B.30-2.
Water Management Strategies Considered for the City of Glen Rose

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Off-channel storage reservoir[(2)] (Section 5A15.3)	2,000	$24,633,000	$1,100
Wastewater Reuse	47	$189,850	$326
Additional Water Conservation	34	$19,500/yr	$574
No Action	-	$12,733,000[3]	$42,443[3]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not needed.
2 Multiple sites are feasible. Cost based on Barker Branch site.
3 Economic impact of not meeting shortage (i.e., “no action”) in 2030 as estimated by TWDB.

5B.30.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Glen Rose:

- Off-channel storage reservoir

5B.30.1.4 Costs

Costs of the recommended plan for the City of Glen Rose to meet 2030 shortages are:

a. Off-channel reservoir:
   - Cost Source: Section 5A.13.3, Table 5A.15-7
   - Date to be Implemented: 2005
   - Total Project Cost: $24,633,000
   - Total Annual Cost: $1,100

Table 5B.30-3.
Recommended Plan Costs by Decade for the City of Glen Rose

	2000	2010	2020	2030	2040	2050
Projected Shortage (acft/yr)	(88)	(161)	(231)	(300)	(367)	(432)
Supply from Plan Elements (acft/yr) (2)	0	748	748	748	748	$748
Annual Cost ($/yr) (2)	0	$768,000	$768,000	$768,000	$171,000	$171,000
Unit Cost ($/acft)(1) (2)	0	$1,027	$1,027	$1,027	$228	$228

1 Unit cost is for full utilization of capacity. Operation and maintenance of existing facilities is not included.
2 Includes 33% of cost of off-channel storage reservoir.

5B.30.2 County-Other

5B.30.2.1 Description of Supply

Water supply for County-Other is groundwater from the Trinity Aquifer. The County-Other entities have a projected shortage of 640 acft in 2030, which is about 57 percent of demand.

5B.30.2.2 Options Considered

Table 5B.30-4 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for County-Other.

Table 5B.30-4.
Water Management Strategies Considered for Somervell County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Off-channel storage reservoir(2)	2,000	$24,633,000	$1,100
No Action	-	$13,271,000[3]	$18,080[3]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not needed.
2 Multiple sites are feasible. Cost based on Barker Branch site.
3 Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.30.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage of County-Other:

- Off-channel storage reservoir

5B.30.2.4 Costs

Costs of the recommended plan for County-Other to meet 2030 shortages are:

a. Off-channel reservoir:
   - Cost Source: Section 5A.13.3, Table 5A.15-7
   - Date to be Implemented: 2005
   - Total Project Cost: $24,633,000

Table 5B.30-5.
Recommended Plan Costs by Decade for Somervell County-Other

Plan Element	2000	2010	2020	2030	2040	2050
Projected Shortage (acft/yr)	74	271	439	640	888	1188
Supply from Plan Elements (acft/yr) (2)	0	1334	1334	1334	1334	1334
Annual Cost ($/yr) (2)	0	$1,467,000	$1,467,000	$1,467,000	$273,000	$273,000
Unit Cost ($/acft)(1) (2)	0	$1,100	$1,100	$1,100	$204	$204

1 Unit cost is for full utilization of capacity. Operation and maintenance of existing facilities is not included.
2 Includes 33% of cost of off-channel storage reservoir.

5B.30.3 Manufacturing

No manufacturing demand exists or is projected for the county.

5B.30.4 Steam-Electric

Squaw Creek Reservoir provides water for TXU's Comanche Peak nuclear power plant. It's supply is set equal to the projected demand, as much of the needed water is pumped from Lake Granbury to keep Squaw Creek Reservoir full. No modifications to the existing system are recommended.

5B.30.5 Mining

5B.30.5.1 Description of Supply

The water supply entities for Mining show a projected surplus through 2030. Therefore, no changes in the water supply system are recommended. However, there is a deficit in 2050, and long-term plans recommend redistribution from municipal supply.

5B.30.5.2 Water Supply Plan

The following plan meets the planning criteria established by the Brazos G RWPG.

- Redistribution from Municipal supply

5B.30.5.3 Costs

Costs of the Recommended Plan for Mining:

a. Redistribution from Municipal supply
   - No modifications to existing system needed
   - Date to be Implemented: In place
   - Total Project Cost: $0

5B.30.6 Irrigation

Somervell County Irrigation is projected to have a surplus of water through 2050 and no changes in water supply are recommended.

5B.30.7 Livestock

No shortages are projected for Somervell County Livestock and no changes in water supply are recommended.

5B.31 Stephens County Water Supply Plan

Table 5B.31-1 lists each water user group in Stephens County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Stephens County, through its County Commissioner's Court, and the City of Breckenridge have submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plans described below either include specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.31-1.
Stephens County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Breckenridge	613	570	Projected surplus
County-Other	16,680	14,705	Projected surplus
Manufacturing	(1)	(1)	Projected shortage – see plan below
Steam-Electric	0	0	No demand or supply
Mining	376	400	Projected surplus
Irrigation	(341)	(328)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4-61 and 4-62, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.31.1 The City of Breckenridge

5B.31.1.1 Description of Supply

The City of Breckenridge obtains water from Hubbard Creek Reservoir through the West Central Texas Municipal Water District.

5B.31.1.2 Water Supply Plan

The City has submitted a letter to the Brazos G RWPG requesting that water treatment, distribution, and storage improvements be included in the recommended plan in order for Breckenridge to provide requested demands of Stephens County Rural WSC, Shackelford County Rural WSC, and other out-of-city demands. The total capital cost of the needed improvements is $2,800,000. Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to be implemented by 2010:

- Capital Improvements Program for regional service.

As a long-term strategy, beyond 2030, for supply to Breckenridge and a regional supply, the following is recommended:

- Use of the Oryx/Kerr-McGee pipeline to deliver treated water from Possum Kingdom Reservoir.

5B.31.1.3 Costs

Costs of the recommended plan for City of Breckenridge prior to 2030 are:

a. Capital Improvements Program for regional service.
   - Cost source: letter from City of Breckenridge, April 17, 2000
   - Date to be Implemented: by 2010
   - Total Project Cost: $2,800,000
   - Total Annual Cost: $213,500

b. Purchase of Possum Kingdom Water delivered through Oryx/Kerr-McGee pipeline
   - Cost source: Section 5.20
   - Date to be Implemented: 2030
   - Total Project Cost: $8,327,000
   - Total Annual Cost: $1,147,000

The Oryx/Kerr-McGee pipeline is also recommended for the City of Abilene, in which case the project would be larger and the economy of scale would cause the unit cost to decrease significantly.

Table 5B.31-2.
Recommended Plan Costs by Decade for City of Breckenridge

Plan Element	2000	2010	2020	2030	2040	2050
Capital Improvements Program						
Supply From Plan Element (acft/yr)	0	not est.	not est.	not. est	not. est.	not est.
Annual Cost ($/yr)	$0	$213,500	$213,500	$213,500	$0	$0
Unit Cost ($/acft)	$0	not est.	not est.	not est.	$0	$0
Possum Kingdom Water through Oryx/Kerr-McGee Pipeline						
Projected Surplus/(Shortage) (acft/yr)	111	42	(44)	(87)	(96)	(94)
Supply From Plan Element (acft/yr)	-	-	-	560	560	560
Annual Cost ($/yr)	-	-	-	$1,147,000	$1,147,000	$1,147,000
Unit Cost ($/acft)	-	-	-	$2,048	$2,048	$2,048

5B.31.2 County-Other Category

Surface water supply is the firm yield of Hubbard Creek Reservoir less existing contract withdrawals. No future shortages are projected and no changes in water supply are recommended in the near-term before 2030. In the long-term, the following project is recommended beyond 2030 to serve County-Other entities.

- Purchase of Possum Kingdom Water delivered through Oryx/Kerr-McGee pipeline (possible joint project with Breckenridge, Abilene, and others).

5B.31.3 Manufacturing

5B.31.3.1 Description of Supply

Stephens County Manufacturing supply is from small, unclassified groundwater resources.

5B.31.3.1 Options Considered

Table 5B.31-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for Manufacturing.

Table 5B.31-3.
Water Management Strategies Considered for Stephens County Manufacturing

Option	Yield (acft/yr)	Approximate Cost Total	Approximate Cost Unit ($/acft)
Voluntary redistribution from Municipal Supply	1	$0	$0
South Bend Reservoir (Section 5A.14.2)	106,700	$241,761,000	$173
No Action	-	$217,000[1]	$217,000[1]

[1] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.31.3.1 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage for Manufacturing:

- Voluntary redistribution from Municipal supply

The South Bend Reservoir has been recommended for consideration for long-term needs for the Brazos River Authority, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if the BRA pursues it, this source should be considered by local entities.

5B.31.3.1 Costs

Costs of the recommended plan to meet 2030 shortages for Manufacturing are:

a. Voluntary redistribution from Municipal supply:
   - No modifications to existing supplies needed
   - Date to be Implemented: In place
   - Total Project Cost: $0

5B.31.4 Steam-Electric

No Steam-Electric demand or supply exists for the county.

5B.31.5 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.31.6 Irrigation

5B.31.6.1 Description of Supply

Surface water supplies in Stephens County are obtained from the Clear Fork of the Brazos River and Lake Hubbard. Estimated reliable annual surface water supplies for Irrigation are 134 acft until 2050. There are no significant groundwater sources in the county.

5B.31.6.2 Options Considered

Table 5B.31-3 lists the water management strategies that were considered for Stephens County irrigation shortages, and references the report section discussing the strategy, total project cost, and unit costs for meeting the shortage.

Table 5B.31-4.
Water Management Strategies Considered for Stephens County Irrigation

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Irrigation System Conversion [1]	92	$10,950/yr	$119
Pecan Micro-irrigation Upgrade [1]	56	$2,460/yr	$44
Brush Control	(*)	(*)	(*)
Weather Modification [2]	(*)	$500,000 to $850,000/yr	(*)
No Action	(*)	$49,000[3]	$144[3]

1 Source of Cost Estimate: Texas Agriculture Experiment Station
2 Source of Cost Estimate: Section 5B.10.
3 Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.
* Definitive yield and/or cost cannot be determined.

5B.31.6.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Irrigation category.

No new water supplies are economically feasible to meet this projected shortage. Water conservation strategies in the form of conversion to irrigation systems with increased efficiency could partially meet the projected shortages. The irrigation systems in Stephens County are relatively efficient. Options are upgrade of side roll systems to center pivots, possibly some renozzling of older center pivots, and conversion of hand moved sprinkler to microirrigation in 50 acres of pecans. Cultural practices such as crop selection, deficit irrigation, and conversion to dryland will account for the remainder of the water conserved (i.e., water not used).

As shown in Table 5B.31-5, conservation practices can meet about 148 acft/yr of the projected irrigation shortage. Apart from the conservation options presented, it is not economically feasible to meet projected Irrigation shortages listed as unmet demand in Stephens County.

5B.31.6.4 Costs

Costs of the Recommended Plan for Stephens County Irrigation supply are outlined in Table 5B6.3. Costs for some options, such as brush control and weather modification, can not be directly quantified due to lack of specific data. Costs for these options have been estimated based on generally available data outlined in the corresponding chapter in Section 5B. Upgrade of 400 acres of sideroll to center pivot would provide a maximum of 92 acft of water annually at a cost of $119/acft. Conversion of pecan irrigation systems would conserve 56-acft at an annual cost of $44/acft.

5B.31.7 Livestock

No future shortages are projected in the Livestock category and no changes in water supply are recommended.

Table 5B.31-5.
Recommended Plan Costs by Decade for Stephens County Irrigation[1]

Plan Element	2000	2010	2020	2030	2040	2050
Irrigation System Conversion[2]						
Projected Shortage (acft/yr) [3]	(360)	(353)	(347)	(341)	(334)	(328)
Supply from Plan Element (acft/yr)	92	92	92	92	92	92
Annual Cost ($/yr)	$10,950	$10,950	$10,950	$10,950	$10,950	$10,950
Unit Cost ($/acft)	$119	$119	$119	$119	$119	$119
Micro-Irrigation Upgrade[2]						
Supply from Plan Element (acft/yr)	56	56	56	56	56	56
Annual Cost ($/yr)	$2,464	$2,464	$2,464	$2,464	$2,464	$2,464
Unit Cost ($/acft)	$44	$44	$44	$44	$44	$44
Weather Modification[4]						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Brush Control						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Sum of Supply from Plan Elements (acft/yr)	(148)	(148)	(148)	(148)	(148)	(148)
Unmet Demand [5]	(212)	(205)	(199)	(193)	(186)	(180)

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for water conserved through management practices. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Texas Agriculture Experiment Station.
3 Total projected irrigation shortages are presented.
4 Source of Cost Estimate: Section 5B.10.
5 Apart from the conservation options presented, it is not economically feasible to meet projected irrigation shortages listed as unmet demand in Stephens County.
* Definitive yield and/or cost cannot be determined.

5B.32 Stonewall County Water Supply Plan

Table 5B.32-1 lists each water user group in Stonewall County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Stonewall County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plans described below either include specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.32-1.
Stonewall County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Aspermont	147	168	Projected surplus – see plan below
County-Other	235	251	Projected surplus – see plan below
Manufacturing	0	0	No demand or supply
Steam-Electric	0	0	No demand or supply
Mining	247	283	Projected surplus
Irrigation	546	574	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-63 and 4-64, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.32.1 The City of Aspermont

5B.32.1.1 Description of Supply

The City of Aspermont is supplied with surface water from local sources and groundwater primarily from the Seymour Aquifer. Groundwater supply is limited by well capacity, and surface water supply is limited due to expiring contract with North Central Texas MWA in 2019.

5B.32.1.2 Options Considered

Table 5B.32-2 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for the City of Aspermont.

Table 5B.32-2.
Water Management Strategies Considered for the City of Aspermont

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Extend existing contract with NCTMWA	93	$60,450/yr	$650[2]
Chloride Control (Section 5A.8)	0	$28,673,000	N/A

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Estimated wholesale cost for treated water from NCTMWA.

5B.32.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet future shortages of the City of Aspermont:

- Extend existing contract with NCTMWA
- Chloride control – Brine Utilization Management Complex

5B.32.1.4 Costs

Costs of the recommended plan for the City of Aspermont to meet future shortages are:

a. Extension of existing contract with NCTMWA:
   - Cost Source: Estimated wholesale cost for treated water
   - Date to be Implemented: 2019
   - Total Annual Cost: $60,450

b. Chloride control:
   - Cost Source: Section 5A.8
   - Date to be Implemented: by 2010
   - Total Annual Cost: $2,427,000 (does not include revenue available from sale of salt)

5B.32.2 County-Other

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.32.3 Manufacturing

No Manufacturing demand exists or is projected for the county.

5B.32.4 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.32.5 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.32.6 Irrigation

The water supply entities for Irrigation show a projected surplus and no changes in water supply are recommended.

5B.32.7 Livestock

No Livestock shortage is projected.

5B.33 Taylor County Water Supply Plan

Table 5B.33-1 lists each water user group in Taylor County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Taylor County, through its County Commissioner's Court, has submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plan described below either includes specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.33-1.
Taylor County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Abilene	(2,610)	(7,067)	Projected shortage – see plan below
City of Merkel	(294)	(355)	Projected shortage – see plan below
City of Potosi	196	206	Projected surplus
City of Tuscola	0	0	Supply equals demand
City of Tye	12	21	Projected surplus
County Other	914	833	Projected surplus
Manufacturing	(1,953)	(2,327)	Projected shortage – see plan below
Steam-Electric	2,319	2,319	Projected surplus
Mining	38	18	Projected surplus
Irrigation	(68)	(47)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4-65 and 4-66, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.33.1 The City of Abilene

5B.33.1.1 Description of Supply

Surface water supplies are obtained from Lakes Fort Phantom Hill, Hubbard Creek, Abilene, and Kirby (irrigation only). City of Abilene surface water supply from Lake O.H. Ivie (Colorado River MWD) is not available to Abilene until infrastructure is constructed to deliver this supply. Abilene has implemented wastewater reuse that currently supplies about 3,000 acft/yr for landscape irrigation.

Based on yield estimates using the historic drought of record, Abilene's current water sources are sufficient beyond 2015 and current projections show a shortage for the year 2030 of 2,610 acft, or about 7 percent of demand. However, reservoir inflows for the 1997-2000 period are less than the historic drought indicating that a new drought-of-record may be occurring. If so, Abilene may need additional sources of water sooner than projections show.

5B.33.1.2 Options Considered

Table 5B.33-2 lists the water management strategies, report section references discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Abilene's shortages.

Table 5B.33-2.
Water Management Strategies Considered for the City of Abilene

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Wastewater Reuse (Section 5A.3)	5,000	$19,250,000	$326
Pipeline from O.H. Ivie Reservoir	15,000	$60,000,000	$400
Coordinated use of Hubbard Creek & Fort Phantom Hill[(2)] (Section 5A.4.2)	7,200	$0	$0
Seymour Aquifer Development (Section 5A.12)	11,100	$31,895,000	$278
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629
Obtain water from Possum Kingdom Reservoir through Oryx/Kerr-McGee Pipeline (5A.20.2)	5,000	$19,500,000	$390
No Action	-	$248,474,000[3]	$95,201[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Requires modifications to existing contracts.
[3] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.33.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Abilene:

- Continue implementation of wastewater reuse.
- Construct pipeline from Ivie Reservoir, which is currently under design.
- Implement coordinated use of Hubbard Creek and Fort Phantom Hill to increase system yield.
- Participate in a regional project to bring water from Possum Kingdom Reservoir through the Oryx/Kerr-McGee pipeline.

Also, the following long-term strategies, beyond 2030, are recommended for consideration:

- ASR (Aquifer Storage & Recovery) in Seymour Aquifer

The Breckenridge Reservoir has been recommended as a major water provider for long-term needs of the West Central Texas Municipal Water District, as described in Section 5B.38. If it is pursued by the WCTMWD, then Abilene should also consider the source.

5B.33.1.4 Costs

Costs of the Recommended Plan for the City of Abilene:

a. Wastewater reuse:
   - Cost Source: Section 5A.3.
   - Date to be Implemented: 2002
   - Approximate unit cost of $326/acft, of which about 90 percent is capital cost.
   - Total Project Cost: $19,250,000 (will require site specific engineering to verify)
   - Total Annual Cost: $1,630,000

b. Pipeline from Ivie Reservoir:
   - Cost Source: Engineering estimates from Freese and Nichols
   - Date to be Implemented: prior to 2015
   - Total Project Cost: $60,000,000

   The pipeline from Ivie Reservoir consists of 52 miles of 36" pipeline, two 24-mgd pump stations, and a 10 million-gallon storage tank.

c. Coordinated use of Hubbard Creek and Fort Phantom Hill
   - Cost Source: Section 5A.4.2
   - Date to be Implemented: 2002
   - Total Project Cost: $0

d. Oryx/Kerr-McGee Pipeline from:
- Cost Source: construction of approximately 40 miles of 18-inch pipeline and pump station.
- Date to be Implemented: prior to 2020
- Unit cost of $390/acft
- Total Project Cost: $19,250,000
- Total Annual Cost: $1,950,000

Table 5B.33-3.
Recommended Plan Costs by Decade for the City of Abilene

Plan Element	***2000***	***2010***	***2020***	***2030***	***2040***	***2050***
Projected Surplus/(Shortage) (acft/yr)	-	-	(106)	(2,610)	(5,263)	(7,067)
Wastewater Reuse						
Supply From Plan Element (acft/yr)	0	5,000	5,000	5,000	5,000	5,000
Annual Cost ($/yr)	0	$1,630,000	$1,630,000	$1,630,000	$163,000	$163,000
Unit Cost ($/acft)	$0	$326	$326	$326	$33	$33
Pipeline From Ivie Reservoir						
Supply From Plan element (acft/yr)	0	0	15,000	15,000	15,000	15,000
Annual Cost ($/yr)	$0	$0	$6,000,000	$6,000,000	$6,000,000	$1,200,000
Unit Cost ($/acft)	$0	$0	$400	$400	$400	$80
Coordinated Use of Hubbard Creek and Ford Phantom Hill						
Supply From Plan Element (acft/yr)	0	7,200	7,200	7,200	7,200	7,200
Annual Cost ($/yr)	$0	$0	$0	$0	$0	$0
Unit Cost ($/acft)	$0	$0	$0	$0	$0	$0
Oryx/Kerr-McGee Pipeline						
Supply From Plan Element (acft/yr)	0	0	5,000	5,000	5,000	5,000
Annual Cost ($/yr)	$0	$0	$1,950,000	$1,950,000	$1,950,000	$390,000
Unit Cost ($/acft)	$0	$0	$390	$390	$390	$78
Total New Supply (acft/yr)	0	12,200	32,200	32,200	32,200	32,200

5B.33.2 The City of Merkel

5B.33.2.1 Description of Supply

The City of Merkel obtains surface water from local sources and from the City of Abilene.

5B.33.2.2 Options Considered

Table 5B.33-4 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for the City of Merkel.

Table 5B.33-4.
Water Management Strategies Considered for the City of Merkel

Option	Yield (acft/yr)	Approximate Cost[1] Total	Approximate Cost[1] Unit ($/acft)
Voluntary redistribution from Abilene	294	$191,100/yr	$650[2]
Wastewater Reuse	104	$420,008	$326
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629[3]
No Action	-	$12,478,000[4]	$42,443[4]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Estimated wholesale rate for treated water.
[3] Raw water cost in the reservoir.
[4] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.33.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Merkel:

- Voluntary redistribution of municipal supply for Abilene
- Wastewater Reuse

The Breckenridge Reservoir has been recommended for the long-term needs of the West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.33.2.4 Costs

Costs of the recommended plan for the City of Merkel to meet 2030 shortages are:

a. Voluntary redistribution of municipal supply for Abilene:
   - Cost Source: Estimated wholesale of $650/acft for treated water
   - Date to be Implemented: In place
   - Total Annual Cost: $191,100

b. Wastewater Reuse
   - Cost Source: Section 5A.3
   - Date to be Implemented: before 2010
   - Total Project Cost: $420,008

Table 5B.33-5.
Recommended Plan Costs by Decade for City of Merkel

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Projected Surplus/(Shortage) (acft/yr)	(213)	(239)	(264)	(294)	(321)	(355)
Voluntary Redistribution from Abilene						
Supply from Plan Elements (acft/yr)	0	294	294	294	294	294
Annual Cost ($/yr)	$0	$191,100	$191,100	$191,100	$191,100	$191,100
Unit Cost ($/acft)	0	$650	$650	$650	$650	$650
Wastewater Reuse						
Supply From Plan Element (acft/yr)	0	104	104	104	104	104
Annual Cost ($/yr)	$0	$34,000	$34,000	$34,000	$3,400	$3,400
Unit Cost ($/acft)	$0	$326	$326	$326	$33	$33
Total New Supply (acft/yr)	0	398	398	398	398	398

5B.33.3 The City of Potosi

The City of Potosi purchases water from the City of Abilene, and shows a projected surplus. Therefore, no changes in water supply are recommended.

5B.33.4 The City of Tuscola

The City of Tuscola purchases water from the City of Abilene, and shows a projected surplus. Therefore, no changes in water supply are recommended.

5B.33.5 City of Tye

The City of Tye purchases water from the City of Abilene, and shows a projected surplus. Therefore, no changes in water supply are recommended.

5B.33.6 County-Other Category

The water supply entities for County-Other show a projected surplus and no changes in water supply are recommended.

5B.33.7 Manufacturing

5B.33.7.1 Description of Supply

Water supply for Manufacturing consists of surface water from local sources along with a small amount of groundwater from the Trinity and Edwards-Trinity (Plateau) Aquifers.

5B.33.7.2 Options Considered

Table 5B.33-6 lists the water management strategies, report section references detailing the strategy, total project cost, and unit costs that were considered for Manufacturing.

Table 5B.33-6.
Water Management Strategies Considered for Taylor County Manufacturing

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Voluntary redistribution from Municipal use	1,953	$0	$0
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629[1]
No Action	-	$311,905,000[2]	$159,705[2]

[1] Raw water cost in the reservoir.
[2] Economic impact of not meeting shortage (i.e., “no action”) in 2030 as estimated by TWDB.

5B.33.7.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage for Manufacturing:

- Voluntary redistribution of municipal supply

The Breckenridge Reservoir has been recommended for the long-term needs for the West Central Texas Municipal Water District, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, then the source should be considered by local entities.

5B.33.7.4 Costs

Costs of the recommended plan to meet 2030 shortages for Manufacturing are:

a. Voluntary redistribution of municipal supply:
   - Cost Source: Estimated wholesale of $650/acft for treated water
   - Date to be Implemented: In place
   - Total Project Cost: $0

5B.33.8 Steam-Electric

The water supply entities for Steam-Electric show a projected surplus and no changes in water supply are recommended.

5B.33.9 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply are recommended.

5B.33.10 Irrigation

5B.33.10.1 Description of Supply

Surface water supplies for Irrigation in Taylor County are obtained from Cedar Creek, Elm Creek, and small tributaries to these streams. The estimated reliable supply of surface water for Irrigation is 138 acft in 2000, then 88 acft until 2050. The groundwater supplies in the county are obtained from the Seymour Aquifer. The estimated reliable supply of groundwater for Irrigation is 286 acft until 2050. A small shortage in Irrigation water supplies exists through the year 2050.

5B.33.10.2 Options Considered

Table 5B.33-7 lists the water management strategies that were considered for Taylor County Irrigation shortages, and references the report section discussing the strategy, total project cost, and unit costs for meeting the shortage.

Table 5B.33-7.
Water Management Strategies Considered for Taylor County Irrigation

Option	Yield (acft/yr)	Approximate Cost: Total	Approximate Cost: Unit ($/acft)
Irrigation System Conversion [1]	68	$2,992/yr	$44
Brush Control (Section 5A.9)	(*)	(*)	(*)
Weather Modification (Section 5A.10)	(*)	$500,000 to $850,000/yr	(*)
No Action	(*)	$41,000[2]	$144[2]

[1] Source of Cost Estimate: Texas Agriculture Experiment Station.
[2] Economic impact of not meeting shortage (i.e., “no action”) in 2030 as estimated by TWDB.
* Definitive yield and/or cost cannot be determined.

5B.33.10.3 Water Supply Plan

Taylor County has projected Irrigation shortages of 68 acft in 2030 and 47 acft in 2050. No new water supplies are economically feasible to meet this projected shortage. Water conservation strategies in the form of conversion to irrigation systems with increased efficiency could partially meet the projected shortages. Options are conversion of gated pipe systems to center pivots and possibly some renozzling of older center pivots. Brush control and weather modification may also be used to enhance soil moisture.

As shown in Table 5B.33-7, conservation practices can meet about 68 acft/yr of the projected shortage. This will meet the projected shortage by the year 2030. Prior to 2030, small irrigation shortages are projected. Apart from the conservation options presented, it is not economically feasible to meet projected Irrigation shortages listed as unmet demand in Taylor County.

5B.33.10.4 Costs

Costs of the Recommended Plan for Irrigation supply are outlined in Table 5B.33-7. Costs for some options, such as brush control and weather modification, can not be directly quantified due to lack of specific data. Costs for these options have been estimated based on generally available data outlined in the corresponding chapter in Section 5B. For irrigation upgrades, conversion of 62 acres of gated pipe to center pivot for fully irrigated forages would provide 68 acft of water annually at a cost of $44/acft.

5B.33.11 Livestock

Livestock water use category shows a projected surplus and no changes in water supply are recommended.

Table 5B.33-7.
Recommended Plan Costs by Decade for the Taylor County Irrigation[1]

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Irrigation System Conversion[2]						
Projected Shortage (acft/yr) [3]	(51)	(89)	(79)	(68)	(58)	(47)
Supply from Plan Element (acft/yr)	68	68	68	68	68	68
Annual Cost ($/yr)	$2,992	$2,992	$2,992	$2,992	$2,992	$2,992
Unit Cost ($/acft)	$44	$44	$44	$44	$44	$44
Brush Control[4]						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Unit Cost ($/acft)	$53	$53	$53	$53	$53	$53
Weather Modification						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Sum of Supply from Plan Elements (acft/yr)	68	68	68	68	68	68
Unmet Demand [5]	0	(21)	(11)	0	0	0

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for water conserved through management practices. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Texas Agriculture Experiment Station.
[3] Total projected irrigation shortages are presented.
[4] Source of Cost Estimate: Section 5B.9.
[5] Apart from the conservation options presented, it is not economically feasible to meet projected irrigation shortages listed as unmet demand in Taylor County.
* Definitive yield and/or cost cannot be determined.

5B.34 Throckmorton County Water Supply Plan

Table 5B.34-1 lists each water user group in Throckmorton County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses. Throckmorton County, through its county commissioner's court, and the City of Woodson have submitted a series of resolutions supporting a variety of regional water supply planning and development initiatives. The specific resolutions are included at the end of Volume 1. The recommended plan described below either includes specific proposed projects mentioned in the resolutions, or are generally consistent with them.

Table 5B.34-1.
Throckmorton County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Throckmorton	(234)	(210)	Projected shortage – see plan below
County-Other	(50)	(43)	Projected shortage – see plan below
Manufacturing	0	0	No demand or supply
Steam-Electric	0	0	No demand or supply
Mining	77	76	Projected surplus
Irrigation	9	9	Projected surplus
Livestock	0	0	Supply equals demand

[1] From Tables 4-67 and 4-68, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.34.1 The City of Throckmorton

5B.34.1.1 Description of Supply

The City of Throckmorton obtains surface water from Lake Throckmorton. A 1969 study by Freese, Nichols, and Endress calculated the firm yield of Lake Throckmorton to be 230 acft/yr, based on the drought of the 1950s. However, current drought conditions in the reservoir show that the yield is insufficient for current demand; therefore, a water supply plan was developed.

5B.34.1.2 Options Considered

Table 5B.34-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Throckmorton's shortage.

Table 5B.34-2.
Water Management Strategies Considered for the City of Throckmorton

Option	*Yield (acft/yr)*	*Approximate Capital Cost*[1]	
		Total	*Unit ($/acft)*
New Reservoir for Throckmorton (Section 5A.14.7)	1,000	$7,500,000	$1,540
Raise Lake Throckmorton	N/A	$2,000,000	N/A
Voluntary Redistribution from Lake Graham	300	$13,000,000	$4,300
Kerr McGee Pipeline (Section 5A.20.2)	560	$8,327,000	$2,048
South Bend Reservoir (Section 5A.14.2)	106,700	$241,761,000	$173
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629
No Action	-	[2]	[2]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.34.1.3 Water Supply Plan

The following plan meets the planning criteria established by the Brazos G RWPG.

- New Reservoir[1] on Elm Creek
- Voluntary Redistribution from Lake Graham

The South Bend Reservoir has been recommended for consideration for long-term needs for the Brazos River Authority, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if the BRA pursues it, this source should be considered by local entities.

[1] New reservoir would require additional investigation to determine if supply is available. If supply is not available, the alternative to obtain water from Lake Graham should be implemented.

The Breckenridge Reservoir has been recommended for consideration for long-term needs for the West Central Texas Municipal Water District, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, this source should be considered by local entities.

5B.34.1.4 Costs

Costs of the Recommended Plan for the City of Throckmorton:

a. New Reservoir on Elm Creek
   - Cost Source: Section 5A.14.7
   - Date to be Implemented: before 2010
   - Total Project Cost: $7,500,000

b. Voluntary Redistribution from Lake Graham
   - Cost is based on 34 miles of 8” pipeline and two 0.27 mgd pump stations, pumping water into the existing Lake Throckmorton.
   - Date to be Implemented: before 2010
   - Total Project Cost: $13,000,000

Table 5B.34-3.
Recommended Plan Costs by Decade for the City of Throckmorton

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Projected Surplus/(Shortage) (acft/yr)	(193)	(184)	(171)	(158)	(148)	(140)
New Reservoir on Elm Creek						
Supply From Plan Element (acft/yr)	0	1,000	1,000	1,000	1,000	1,000
Annual Cost ($/yr)	$0	$1,540,000	$1,540,000	$1,540,000	$180,000	$180,000
Unit Cost ($/acft)	$0	$1,540	$1,540	$1,540	$180	$180
Voluntary Redistribution From Lake Graham						
Supply From Plan Element (acft/yr)	0	300	300	300	300	300
Annual Cost ($/yr)	$0	$1,290,000	$1,290,000	$1,290,000	$250,000	$250,000
Unit Cost ($/acft)	$0	$4,300	$4,300	$4,300	$833	$833
Total New Supply (acft/yr)	0	1,300	1,300	1,300	1,300	1,300

5B.34.2 County-Other

5B.34.2.1 Description of Supply

Water supply is obtained from local sources and limited groundwater use. Within the County-Other category, the town of Woodson has projected shortages.

5B.34.2.2 Options Considered

Table 5B.34-4 lists the water management strategies, references to the report section detailing the strategy, total project cost, and unit costs that were considered for County-Other (Woodson).

Table 5B.34-4.
Water Management Strategies Considered for Throckmorton County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Voluntary redistribution from Hubbard Creek Reservoir to Woodson	50	2,100,000	$4,200
New reservoir for Woodson (Section 5A.14.7)	100	$4,500,000	$3,600
Raise Lake Woodson	[2]	$2,000,000	[2]
Kerr-McGee Pipeline (Section 5A.14.8)	560	$8,327,000	$2,048
South Bend Reservoir (Section 5A.14.2)	106,700	$241,761,000	$173
Breckenridge Reservoir (Section 5A.14.1)	20,000	$171,462,000	$629
No Action	-	$904,000[3]	$18,080[3]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity. Operation and maintenance of existing facilities is not included.
[2] Not available at time of printing.
[3] Economic impact of not meeting shortage (i.e., "no action") in 2030 as estimated by TWDB.

5B.34.2.3 Water Supply Plan

The following plan meets the planning criteria established by the Brazos G RWPG.

- New Reservoir[2]
- Voluntary Redistribution from Hubbard Creek Reservoir

The South Bend Reservoir has been recommended for consideration for long-term needs for the Brazos River Authority, as a major water provider, as described in Section 5B.38. The

[2] New reservoir would require additional investigation to determine if supply is available. If supply is not available, the alternative to obtain water from Hubbard Creek Reservoir should be implemented.

project is much too large to be pursued by any individual municipality, but if the BRA pursues it, this source should be considered by local entities.

The Breckenridge Reservoir has been recommended for consideration for long-term needs for the West Central Texas Municipal Water District, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if it is pursued by the WCTMWD, this source should be considered by local entities.

5B.34.2.4 Costs

Costs of the Recommended Plan for County-Other.

a. New Reservoir
   - Cost Source: Section 5A.14.7
   - Date to be Implemented: before 2010
   - Total Project Cost: $4,500,000

b. Voluntary Redistribution from Hubbard Creek Reservoir
   - Cost Source: *Regional Water Supply Plan*, developed for West Central Texas Municipal Water District in 1991 by Freese and Nichols. This cost includes 130 gpm pump, 64,000' of 8" line, a 100,000 gallon water storage tank, and a 0.03 MGD treatment plant expansion.
   - Date to be Implemented: before 2010
   - Total Project Cost: $2,100,000

Table 5B.34-5.
Recommended Plan Costs by Decade for Throckmorton County-Other

	2000	2010	2020	2030	2040	2050
Projected shortage[1] (acft)	73	67	58	50	43	43
Supply from Plan Elements (acft)	0	100	100	100	100	100
Annual Costs ($/yr)	0	$360,000	$360,000	$360,000	$33,000	$33,000
Unit costs ($/ac-ft)	0	$3,600	$3,600	$3,600	$330	$330

[1] Assumes safe yield, extension of all existing contracts, and provisions for manufacturing use deficit.

5B.34.3 Manufacturing

No Manufacturing demand exists or is projected for the county.

5B.34.4 Steam-Electric

No Steam-Electric demand exists or is projected for the county.

5B.34.5 Mining

The water supply entities for Mining show a projected surplus and no changes in water supply system are recommended.

5B.34.6 Irrigation

No projected shortage exists and no change in water supply is recommended.

5B.34.7 Livestock

No projected shortage exists and no change in water supply is recommended.

5B.35 Washington County Water Supply Plan

Table 5B.35-1 lists each water user group in Washington County and their corresponding surplus or shortage in years 2030 and 2050.

Table 5B.35-1.
Washington County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Brenham	2,079	2,283	Projected surplus
County-Other	9,720	10,046	Projected surplus
Manufacturing	1,685	1,591	Projected surplus
Steam-Electric	(0)	(0)	No Projected Surplus/(Shortage)
Mining	552	547	Projected surplus
Irrigation	362	362	Projected surplus
Livestock	(0)	(0)	No Projected Surplus/(Shortage)

[1] From Tables 4-69 and 4-70, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.35.1 City of Brenham

The City of Brenham obtains its water supply from Lake Somerville with one emergency back-up well that can produce water from the Gulf Coast Aquifer. The city has contracted with the Brazos River Authority for 4,619 acft/yr of water supply from Lake Somerville that exceeds its year 2050 needs of 2,336 acft/yr. No changes in water supply are recommended.

5B.35.2 County-Other

County-Other is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.35.3 Manufacturing

Manufacturing is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.35.4 Steam-Electric

No Steam-Electric demand exists nor is projected for the county.

5B.35.5 Mining

Mining is projected to have a surplus of water through the year 2050 and no changes in water supply are recommended.

5B.35.6 Irrigation

Irrigation is projected to have a surplus of water from available groundwater and surface water supplies and no changes in water supply are recommended.

5B.35.7 Livestock

No shortages are projected for Livestock use and no changes in water supply are recommended.

5B.36 Williamson County Water Supply Plan

Table 5B.36-1 lists each water user group in Williamson County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider.

Table 5B.36-1.
Williamson County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1]		Comment
	2030 (acft/yr)	2050 (acft/yr)	
City of Bartlett	49	27	Projected surplus
Brushy Creek MUD (CDP)	(4,020)	(3,887)	Projected shortage – see plan below
City of Cedar Park	7,584	6,584	Projected surplus
City of Florence	(136)	(212)	Projected shortage – see plan below
City of Georgetown	(8,151)	(18,535)	Projected shortage – see plan below
City of Granger	(129)	(224)	Projected shortage – see plan below
City of Hutto	(265)	(550)	Projected shortage – see plan below
City of Leander	1,931	(171)	Projected shortage – see plan below
City of Round Rock	(12,157)	(21,543)	Projected shortage – see plan below
City of Taylor	590	(1,507)	Projected shortage – see plan below
City of Thrall	(40)	(63)	Projected shortage – see plan below
County-Other	(11,750)	(11,302)	Projected shortage – see plan below
Manufacturing	4,971	4,895	Projected surplus
Steam-Electric	0	0	No demand or supply
Mining	(1,543)	(1,663)	Projected shortage – see plan below
Irrigation	797	797	Projected surplus
Livestock	0	0	No shortage

[1] From Tables 4-71 and 4-72, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.36.1 City of Bartlett

The City of Bartlett is in both Bell and Williamson Counties, consequently, its water demand and supply values are split into the tables for each county. Bartlett's water supply is groundwater from both the Trinity and Edwards Aquifers. No future shortages are projected for the City of Bartlett and no changes in water supply are recommended.

5B.36.2 Brushy Creek Municipal Utility District

The Brushy Creek Municipal Utility District (BCMUD) currently has a contract for water supply from the City of Round Rock which expires in 2006. In 1994 the BCMUD entered into an agreement with the Brazos River Authority (BRA) to purchase 4,000 acft/yr of water from Stillhouse Hollow Reservoir, and became part of the Williamson County Regional Project. This water supply was intended to serve as a replacement supply for the water that is currently being obtained from the City of Round Rock. According to the contract with BRA, the BCMUD is responsible for 9.551 percent of the Regional Project. The BCMUD is currently evaluating several options for treating and delivering water to the District. Presently, the MUD is working toward construction of its own water treatment plant and transmission line. However, the MUD also continues to consider options for development of a regional water treatment plant, and the potential for more economical approaches that would provide a cost effective equivalent water supply from the LCRA.

5B.36.2.2 Options Considered

Table 5B.36-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting Brushy Creek MUD's shortage.

5B.36.2.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of Brushy Creek MUD:

- Diversion and treatment facilities to use Lake Stillhouse Hollow water delivered to Lake Georgetown.

Table 5B.36-2.
Water Management Strategies Considered for Brushy Creek MUD

Option	*Yield (acft/yr)*	*Approximate Cost*[1]	
		Total	*Unit ($/acft)*
Additional Water Conservation (Section 5A.2)	200	$115,000/yr	$574[2]
Wastewater Reuse (Section 5A.3)	400	$1,615,000	$326[3]
Voluntary Redistribution from In-County Source, Transmission through existing facilities	4,000	$3,250,000/yr	$812[4]
Voluntary Redistribution from City of Austin	4,000	$3,000,000/yr	$750[5]
Diversion and treatment facilities to use Lake Stillhouse Hollow water through Lake Georgetown	4,000	$3,028,000/yr	$757[6]
Carrizo-Wilcox Aquifer Development (Section 5A.17)	36,514	$189,341,000	$699
Little River Reservoir (Section 5A.14)	129,000	$361,065,000	$197[7]
No Action	-	$147,264,000[8]	$61,565[8]

1 Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
2 Source of Cost Estimate: Section 5A.2.
3 Source of Cost Estimate: Table 5A.3.
4 Estimated wholesale treated water rate.
5 Estimated wholesale treated water rate. Does not include cost of new treatment or delivery facilities, if needed. Does not include cost for use of City of Round Rock facilities, if needed.
6 Estimated unit cost of stand-alone diversion, treatment, and transmission facilities from Lake Georgetown to BCMUD. Source: "Water Supply System Rate Analysis," BCMUD, June 2000.
7 Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
8 Economic Impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.36.2.4 Costs

Costs of the Recommended Plan for Brushy Creek MUD:

a. Diversion and treatment facilities to use Lake Stillhouse Hollow water delivered to Lake Georgetown:
   - Cost Source: "Water Supply System Rate Analysis, Williamson County Regional Water Project and External Water Treatment and Transmission Facilities" prepared for Brushy Creek MUD by Naismith Engineering, Inc., June 2000.
   - Date to be Implemented: By year 2006
   - Annual Cost: $2,970,000 per year

5B.36.3 City of Cedar Park

The City of Cedar Park purchases water from the Lower Colorado River Authority at Lake Travis. No shortages are projected for the City of Cedar Park and no changes in water supply are recommended.

Table 5B.36-3.
Recommended Plan Costs by Decade for Brushy Creek MUD

Plan Element	2000	2010	2020	2030	2040	2050
Voluntary Redistribution						
Projected Surplus/(Shortage) (acft/yr)	1,147	(3,630)	(3,889)	(4,020)	(3,914)	(3,887)
Supply From Plan Element (acft/yr)	-	4,000	4,000	4,000	4,000	4,000
Annual Cost ($/yr)	-	$3,028,000	$3,287,000	$1,355,000	$1,355,000	$1,355,000
Unit Cost ($/acft)	-	$757	$822	$339	$339	$339

5B.36.4 City of Florence

5B.36.4.1 Description of Supply

The City of Florence relies on Trinity Aquifer groundwater for its supply. Although Florence's pumping capability is significantly greater, proration of estimated reliable groundwater in Williamson County results in an allocation of about 204 acft/yr to Florence.

5B.36.4.2 Options Considered

The City of Florence has a shortage of 136 acft per year in 2030, which is about 40 percent of demand. Table 5B.36-4 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Florence's shortage.

5B.36.4.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Florence:

- Voluntary Redistribution from Brazos River Authority, Transmission and Treatment through existing Central Texas WSC and Chisholm Trail SUD facilities; source will probably be Lake Stillhouse Hollow; City of Florence will need to negotiate for about 250 acft per year of water from either BRA or an existing contract holder.

Table 5B.36-4.
Water Management Strategies Considered for the City of Florence

Option	*Yield (acft/yr)*	*Approximate Cost[1]*	
		Total	*Unit ($/acft)*
Additional Water Conservation (Section 5A.2)	20	$11,500/yr	$574[2]
Voluntary Redistribution from City of Georgetown, Chisholm Trail SUD, or BRA	250	$244,000/yr	$975[3]
Carrizo-Wilcox Aquifer water purchased through Chisholm Trail SUD (Section 5A.17)	36,514	$189,341,000	$699
No Action	-	$5,772,000[5]	$42,443[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2
[3] Estimated wholesale treated water rate. Costs of delivery facilities, if needed, are not included.
[4] Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
[5] Economic Impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.36.4.4 Costs

Costs of the Recommended Plan for the City of Florence.

a. Voluntary Redistribution:
- Cost Source: estimated wholesale treated water rate
- Date to be Implemented: By year 2010
- Annual Cost: $244,000 per year

Table 5B.36-5.
Recommended Plan Costs by Decade for the City of Florence

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Voluntary Redistribution						
Projected Surplus/(Shortage) (acft/yr)	111	42	(44)	(87)	(96)	(94)
Supply From Plan Element (acft/yr)	-	250	250	250	250	250
Annual Cost ($/yr)	-	$244,000	$244,000	$244,000	$244,000	$244,000
Unit Cost ($/acft)	-	$975	$975	$975	$975	$975

5B.36.5 City of Georgetown

5B.36.5.1 Water Supply

The City of Georgetown purchases water from the Brazos River Authority at Lake Georgetown and at Lake Stillhouse Hollow. Their water purchase contracts total 22,168 acft/yr. Water from Lake Stillhouse Hollow will be delivered to Lake Georgetown through the Williamson County Raw Waterline. This water supply is sufficient to meet Georgetown's needs beyond 2040. However, Georgetown's estimated diversion capacity at Lake Georgetown is about 8,344 acft/yr and they will need to construct additional intake and conveyance facilities to fully use the remaining 13,824 acft/yr that is under contract. Georgetown also pumps groundwater from the Edwards Aquifer and the estimated reliable supply is about 921 acft/yr. Georgetown is also implementing wastewater reuse projects where appropriate to meet demands with non-potable water.

5B.36.5.2 Options Considered and Recommended Plan

The shortage reported for Georgetown of 8,151 acft/yr in 2030, is a result of infrastructure constraints of their intake and conveyance facilities. The following water supply plan is recommended to meet the projected 2030 shortage of the City of Georgetown:

- Expand intake, pumping, and conveyance facilities at Lake Georgetown
- Construct river intake, pumping, and conveyance facilities to use the Park plant to treat surface water

5B.36.5.3 Costs

Costs of the Recommended Plan for the City of Georgetown:

- Cost Source: HDR Engineering, "Evaluation of Water Supply Alternatives for the City of Georgetown", July 2000.
- Date to be Implemented: By year 2010
- Total Project Cost: $3,494,000
- Total Annual Cost: $266,000

Table 5B.36-6.
Recommended Plan Costs by Decade for the City of Georgetown

Plan Element	2000	2010	2020	2030	2040	2050
Infrastructure Improvements						
Projected Surplus/(Shortage) (acft/yr)	2,213	(1,179)	(4,561)	(8,151)	(12,697)	(18,535)
Supply From Plan Element (acft/yr)	-	13,824	13,824	13,824	13,824	13,824
Annual Cost ($/yr)	-	$266,000	$266,000	$266,000	$0	$0
Unit Cost ($/acft)	-	$19	$19	$19	$19	$19

5B.36.5.4 Long-term Strategies

The following long-term strategies, beyond 2030, are recommended to meet Georgetown's water needs:

- Participate in the Little River Reservoir project; water availability up to 129,000 acft/yr; total project cost: $361,000,000; unit cost of raw water in the reservoir: $197/acft.
- Develop a groundwater supply from the Carrizo-Wilcox Aquifer; water availability up to 36,500 acft; total project cost: $189,341,000; unit cost of treated water delivered to Georgetown: $699/acft.
- Purchase water from BRA/LCRA Alliance; water availability up to 25,000 acft; total project cost: $126,457,000; unit cost of treated water delivered to Williamson County: $597.

5B.36.6 City of Granger

5B.36.6.1 Description of Supply

The City of Granger obtains it's water supply from the Trinity Aquifer.

5B.36.6.2 Options Considered

The City of Granger has a projected shortage of 129 acft per year in 2030, which is about 34 percent of demand. Table 5B.36-7 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Granger shortage.

Table 5B.36-7.
Water Management Strategies Considered for the City of Granger

Option	***Yield (acft/yr)***	***Approximate Cost[1]***	
		Total	***Unit ($/acft)***
Additional Water Conservation (Section 5A.2)	20	$11,500/year	$574[2]
Little River Reservoir (Section 5A.14)	129,000	$361,065,000	$197[3]
Voluntary Redistribution from City of Taylor, BRA, or other	250	$203,000/yr	$812[4]
Carrizo-Wilcox Aquifer (Section 5A.17)	36,514	$189,341,000	$699
No Action	-	$5,475,000[5]	$42,443[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
[4] Estimated wholesale treated water cost.
[5] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.36.6.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Granger:

- Participate in a regional water supply project with the City of Taylor and obtain water either from the Brazos River Authority (Lake Granger) or from the Carrizo-Wilcox Aquifer.

5B.36.6.4 Costs

Costs of the recommended plan for the City of Granger to meet 2030 shortages are:

a. Regional water supply system:
   - Cost Source: Section 5A.17 cost table (for Carrizo-Wilcox supply option)
   - Date to be Implemented: By year 2010
   - Total Project Cost (Granger's portion): $1,237,000
   - Annual Cost: $175,000 per year

   Cost is based on unit rate of $699/acft (actual cost to Granger is likely to be lower). Debt service is 54% of total annual cost (Table 5.17-2). Total project cost is for Granger's portion of project.

Table 5B.36-8.
Recommended Plan Costs by Decade for the City of Granger

Plan Element	2000	2010	2020	2030	2040	2050
Carrizo-Wilcox Aquifer						
Projected Surplus/(Shortage) (acft/yr)	- -	(47)	(66)	(129)	(179)	(224)
Supply From Plan Element (acft/yr)	-	250	250	250	250	250
Annual Cost ($/yr)	-	$175,000	$175,000	$175,000	$175,000	$175,000
Unit Cost ($/acft)	-	$699	$699	$699	$699	$699

5B.36.7 City of Hutto

5B.36.7.1 Description of Supply

The City of Hutto obtains its water supply from the Trinity and Edwards Aquifers.

5B.36.7.2 Options Considered

The City of Hutto has a projected shortage of 265 acft per year in 2030, which is about 67 percent of demand. Table 5B.36-9 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the City of Hutto shortage.

Table 5B.36-9.
Water Management Strategies Considered for the City of Hutto

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	20	$11,500/year	$574[2]
Little River Reservoir (Section 5A.14)	129,000	$361,065,000	$197[3]
Voluntary Redistribution from City of Taylor, BRA, or other	600	$487,000/yr	$812[4]
Carrizo-Wilcox Aquifer (Section 5A.17)	36,514	$189,341,000	$699
No Action	-	$11,247,000[5]	$42,443[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Section 5A.14. Unit Cost for raw water. Treatment and transmission costs for individual users would be additional.
[4] Estimated wholesale treated water cost.
[5] Economic Impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.36.7.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Hutto:

- Participate in a regional water supply project with the City of Taylor and obtain water either from the Brazos River Authority (Lake Granger) or from the Carrizo-Wilcox Aquifer.

5B.36.7.4 Costs

Costs of the recommended plan for the City of Hutto to meet 2030 shortages are:

a. Regional water supply system:
   - Cost Source: Section 5A.17 cost table (for Carrizo-Wilcox supply option)
   - Date to be Implemented: By year 2010
   - Total Project Cost (Granger's portion): $2,970,000
   - Annual Cost: $419,000 per year

   Cost is based on unit rate of $699/acft. Debt service is 54% of total annual cost (Table 5.17-2). Total project cost is for Hutto's portion of project.

Table 5B.36-10.
Recommended Plan Costs by Decade for the City of Hutto

Plan Element	2000	2010	2020	2030	2040	2050
Carrizo-Wilcox Aquifer						
Projected Surplus/(Shortage) (acft/yr)	- -	(63)	(150)	(265)	(401)	(550)
Supply From Plan Element (acft/yr)	-	600	600	600	600	600
Annual Cost ($/yr)	-	$419,000	$419,000	$419,000	$419,000	$419,000
Unit Cost ($/acft)	-	$699	$699	$699	$699	$699

5B.36.8 City of Leander

5B.36.8.1 Description of Supply

The City of Leander has contracted with the Lower Colorado River Authority to purchase treated water from Lake Travis. Leander also has a supply contract with Chisholm Trail SUD and pumps groundwater from the Trinity Aquifer. Based on these supply sources, Leander's needs are met beyond 2040 and no change in their water supply situation is recommended.

5B.36.9 City of Round Rock

5B.36.9.1 Water Supply

The City of Round Rock purchases water from the Brazos River Authority at Lake Georgetown and at Lake Stillhouse Hollow. Their water purchase contracts total 24,854 acft/yr. Water from Lake Stillhouse Hollow will be delivered to Lake Georgetown through the Williamson County Raw Waterline. This water supply is sufficient to meet Round Rock's needs until about 2015. Round Rock's estimated diversion capacity at Lake Georgetown is limited to about 17,800 acft/yr and they will need to construct additional intake and conveyance facilities to fully use the remaining 7,000 acft/yr that is under contract. Round Rock also pumps groundwater from the Edwards Aquifer and the estimated reliable supply is about 921 acft/yr. Round Rock is also implementing wastewater reuse projects.

5B.36.9.2 Options Considered

The shortage reported for Round Rock is 12,157 acft/yr in 2030 and 21,543 acft/yr in 2050. About 7,000 acft/yr of this shortage results from intake and conveyance constraints at Lake Georgetown. Table 5B.36-11 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting Round Rock's shortage.

5B.36.9.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the City of Round Rock:

- Expand the raw water intake and conveyance facilities at Lake Georgetown (7,000 acft/yr).
- Participate in a regional Carrizo-Wilcox Aquifer supply project (6,000 acft/yr).
- Purchase Lake Travis water from the BRA/LCRA Alliance (6,000 acft/yr).
- Continue to implement wastewater reuse (5,000 acft/yr)

Table 5B.36-11.
Water Management Strategies Considered for the City of Round Rock

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	1,500	$861,000/yr	$574[2]
Wastewater Reuse (Section 5A.3)	5,000	$19,239,000	$326[3]
Expand intake and conveyance facilities at Lake Georgetown	7,000	$1,744,000	$19[4]
Voluntary Redistribution from LCRA (Section 5.16.3)	36,514	$125,457,000	$597
Carrizo-Wilcox Aquifer Development (Section 5A.17)	36,514	$189,341,000	$699
Little River Reservoir (Section 5A.14)	129,000	$361,065,000	$197[5]
No Action	-	$1,157,354,000[6]	$95,201[6]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Table 5A.3.
[4] Same unit cost as upgrade of Georgetown's facilities.
[5] Source of Cost Estimate: Section 5A.14. Unit cost for raw water. Treatment and transmission costs for individual users would be additional.
[6] Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.36.9.4 Costs

Costs of the recommended plan for the City of Round Rock:

a. Expand the raw water intake and conveyance facilities at Lake Georgetown:
   - Cost Source: use estimated unit cost from City of Georgetown water supply evaluation (See Section 5B.36.4.3)
   - Date to be Implemented: By year 2010
   - Total Project Cost: $1,744,000
   - Annual Cost: $133,000

b. Participate in a regional Carrizo-Wilcox Aquifer supply project:
   - Cost Source: Section 5A.17
   - Date to be Implemented: By year 2010
   - Total Project Cost: $29,702,000
   - Annual Cost: $4,194,000

   Cost is based on unit rate of $699/acft applied to Round Rock's portion of about 6,000 acft/yr. Debt service is 54% of total annual cost (Table 5.17-2). Total project cost is for Round Rock's portion only.

c. Purchase Lake Travis water from the BRA/LCRA Alliance.

- Cost Source: Section 5A.16
- Date to be Implemented: By year 2020
- Total Project Cost: $19,730,000
- Annual Cost: $3,582,000

Cost is based on unit rate of $597/acft applied to Round Rock's portion of about 6,000 acft/yr. Debt service is 42% of total annual cost (Table 5.16-8). Total project cost is for Round Rock's portion only.

d. Wastewater Reuse.

- Cost Source: Section 5A.3
- Date to be Implemented: By year 2030
- Total Project Cost: $19,239,000
- Annual Cost: $1,630,000

Table 5B.36-12.
Recommended Plan Costs by Decade for City of Round Rock

Plan Element	2000	2010	2020	2030	2040	2050
Projected Surplus/(Shortage) (acft/yr)	5,343	(990)	(7,663)	(12,157)	(16,636)	(21,543)
Expand Intake/Conveyance Facilities at Lake Georgetown						
Supply From Plan Element (acft/yr)	-	7,000	7,000	7,000	7,000	7,000
Annual Cost ($/yr)	-	$133,000	$133,000	$133,000	$0	$0
Unit Cost ($/acft)	-	$19	$19	$19	$0	$0
Carrizo-Wilcox Aquifer Supply						
Supply From Plan Element (acft/yr)	-	6,000	6,000	6,000	6,000	6,000
Annual Cost ($/yr)	-	$4,194,000	$4,194,000	$4,194,000	$1,929,000	$1,929,000
Unit Cost ($/acft)	-	$699	$699	$699	$321	$321
BRA/LCRA Alliance Supply from Lake Travis						
Supply From Plan Element (acft/yr)	-	-	6,000	6,000	6,000	6,000
Annual Cost ($/yr)	-	-	$3,582,000	$3,582,000	$3,582,000	$2,078,000
Unit Cost ($/acft)	-	-	$597	$597	$597	$346
Wastewater Reuse						
Supply From Plan Element (acft/yr)	-	-	-	5,000	5,000	5,000
Annual Cost ($/yr)	-	-	-	$1,630,000	$1,630,000	$1,630,000
Unit Cost ($/acft)	-	-	-	$326	$326	$326
Total New Supply (acft/yr)	0	13,000	19,000	28,000	28,000	28,000

5B.36.9.5 Long-term Strategies

The following long-term strategies, beyond 2030, are recommended to meet Round Rock's water needs:

- Participate in the Little River Reservoir project; water availability up to 129,000 acft/yr; total project cost: $361,000,000; unit cost of raw water in the reservoir: $197/acft.

5B.36.10 City of Taylor

5B.36.10.1 Description of Supply

The City of Taylor purchases 8,525 acft/yr of surface water from the Brazos River Authority at Lake Granger and this supply is projected to be sufficient past year 2050. However, water shortages are created by infrastructure limitations sometime after 2030 and water intake, conveyance, and treatment capacity expansions will be needed to utilize contracted water.

5B.36.10.2 Options Considered

The City of Taylor has an infrastructure–caused shortage of 1,507 acft/yr in 2050, which is about 19 percent of demand in 2050. Options considered to meet this projected long-term shortage are:

- Infrastructure expansion (2,250 acft/yr)
- Water conservation (400 acft/yr)
- Little River Reservoir (1,507 acft/yr)
- Carrizo-Wilcox Aquifer Supply (1,507 acft/yr)

5B.36.10.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2050 shortage of the City of Taylor:

- Infrastructure expansion to supply 2,250 acft/yr (2.0 MGD)
- Carrizo-Wilcox Aquifer project to supply 1,507 acft/yr.

5B.36.10.4 Costs

Costs of the Recommended Plan for the City of Taylor:

a. Infrastructure expansion for City of Taylor:
   - Cost Source: HDR Engineering (consultant to City of Taylor)
   - Date to be Implemented: By year 2035
   - Total Project Cost: $7,439,000
   - Annual Cost: $621,000

   Cost is based on 2 MGD new intake pumping station, conveyance, and treatment facilities.

b. Carrizo-Wilcox Aquifer supply:
   - Cost Source: Section 5A.17
   - Date to be Implemented: By year 2035
   - Total Project Cost: $7,460,000
   - Annual Cost: $1,053,000

   Cost is based on unit rate of $699/acft applied to Taylor's portion of about 1,507 acft/yr. Debt service is 54% of total annual cost (Table 5A.17-2). Total project cost is for Taylor's portion only.

Table 5B.36-13.
Recommended Plan Costs by Decade for the City of Taylor

Plan Element	2000	2010	2020	2030	2040	2050
Projected Surplus/(Shortage) (acft/yr)	3,435	2,577	1,296	590	(212)	(1,507)
Infrastructure Expansion						
Supply From Plan Element (acft/yr)	-	-	-	-	2,250	2,250
Annual Cost ($/yr)	-	-	-	-	$621,000	$621,000
Unit Cost ($/acft)	-	-	-	-	$276	$276
Carrizo-Wilcox Aquifer Supply						
Supply From Plan Element (acft/yr)	-	-	-	1,507	1,507	1,507
Annual Cost ($/yr)	-	-	-	$1,053,000	$1,053,000	$1,053,000
Unit Cost ($/acft)	-	-	-	$699	$699	$699

5B.36.11 City of Thrall

The City of Thrall obtains its water supply from groundwater from the Trinity Aquifer and through Noack WSC from the City of Taylor. Thrall has a projected shortage of 40 acft/yr in 2030 and 63 acft/yr shortage in 2050. The recommended plan for Thrall to meet this projected shortage is to continue buying water from Taylor and to negotiate a contract to receive additional water sufficient to meet needs.

Table 5B.36-14.
Recommended Plan Costs by Decade for the City of Thrall

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Voluntary Redistribution from City of Taylor						
Projected Surplus/(Shortage) (acft/yr)	- -	(4)	(19)	(40)	(50)	(63)
Supply From Plan Element (acft/yr)	-	70	70	70	70	70
Annual Cost ($/yr)	-	$56,800	$56,800	$56,800	$56,800	$56,800
Unit Cost ($/acft)	-	$812	$812	$812	$812	$812

5B.36.12 County-Other

5B.36.12.1 Water Supply

Entities in the County-Other category in Williamson County obtain their water supply from groundwater (Trinity and Edwards Aquifers), the Brazos River Authority at Lake Georgetown and Lake Stillhouse Hollow, and by purchasing from adjacent cities. Jonah Special Utility District and Chisholm Trail Special Utility District both purchase water from the Brazos River Authority at Lake Stillhouse Hollow. Water from Lake Stillhouse Hollow will be delivered to Lake Georgetown through the Williamson County Raw Waterline. The County-Other category is shown to have a current shortage, based primarily on the conservatively low groundwater supply values in the projections. The projected shortages increase to 11,750 acft/yr in 2030 and then stay relatively the same through 2050. Because the County-Other demands are closely linked to what is occurring in the cities, and because the shortages are similar, the options and plan presented here is similar to the City of Round Rock plan.

5B.36.12.2 Options Considered

Table 5B.36-15 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for meeting the Williamson County-Other shortage.

Table 5B.36-15.
Water Management Strategies Considered for Williamson County-Other

Option	Yield (acft/yr)	Approximate Cost[1]	
		Total	Unit ($/acft)
Additional Water Conservation (Section 5A.2)	1,500	$861,000/yr	$574[2]
Wastewater Reuse (Section 5A.3)	5,000	$19,239,000	$326[3]
Voluntary Redistribution from LCRA (Section 5.16.3)	36,514	$125,457,000	$597
Carrizo-Wilcox Aquifer Development (Section 5.17)	36,514	$189,341,000	$699
Little River Reservoir (Section 5A.14)	129,000	$361,065,000	$197[4]
No Action	-	$244,864,000[5]	$18,080[5]

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for treated water delivered to the water supply entity or entities. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5A.2.
[3] Source of Cost Estimate: Table 5A.3.
[4] Source of Cost Estimate: Section 5A.14. Unit cost for raw water. Treatment and transmission costs for individual users would be additional.
[5] Economic Impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.36.12.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of County-Other in Williamson County:

- Participate in a regional Carrizo-Wilcox Aquifer supply project (6,000 acft/yr).
- Purchase Lake Travis water from the BRA/LCRA Alliance (6,000 acft/yr).
- Continue to implement wastewater reuse (5,000 acft/yr)

5B.36.12.4 Costs

Costs of the Recommended Plan for County-Other.

a. Participate in a regional Carrizo-Wilcox Aquifer supply project.
   - Cost Source: Section 5A.17
   - Date to be Implemented: By year 2010
   - Total Project Cost: $29,702,000
   - Annual Cost: $4,194,000

   Cost is based on unit rate of $699/acft applied to County-Other portion of about 6,000 acft/yr. Debt service is 54% of total annual cost (Table 5.17-2). Total project cost is for County-Other portion only.

b. Purchase Lake Travis water from the BRA/LCRA Alliance.
   - Cost Source: Section 5A.16

- Date to be Implemented: By year 2020
- Total Project Cost: $19,730,000
- Annual Cost: $3,582,000

  Cost is based on unit rate of $597/acft applied to County-Other portion of about 6,000 acft/yr. Debt service is 42% of total annual cost (Table 5.16-8). Total project cost is for County-Other portion only.

c. Wastewater Reuse.

- Cost Source: Section 5A.3
- Date to be Implemented: By year 2030
- Total Project Cost: $19,239,000
- Annual Cost: $1,630,000

5B.36.12.5 Long-term Strategies

The following long-term strategies, beyond 2030, are recommended to meet County-Other water needs:

- Participate in the Little River Reservoir project; water availability up to 129,000 acft/yr; total project cost: $361,000,000; unit cost of raw water in the reservoir: $197/acft.

Table 5B.36-16.
Recommended Plan Costs by Decade for County-Other in Williamson County

Plan Element	*2000*	*2010*	*2020*	*2030*	*2040*	*2050*
Projected Surplus/(Shortage) (acft/yr)	(713)	(2,232)	(8,693)	(11,750)	(12,818)	(11,302)
Carrizo-Wilcox Aquifer Supply						
Supply From Plan Element (acft/yr)	-	6,000	6,000	6,000	6,000	6,000
Annual Cost ($/yr)	-	$4,194,000	$4,194,000	$4,194,000	$1,929,000	$1,929,000
Unit Cost ($/acft)	-	$699	$699	$699	$321	$321
BRA/LCRA Alliance Supply from Lake Travis						
Supply From Plan Element (acft/yr)	-	-	6,000	6,000	6,000	6,000
Annual Cost ($/yr)	-	-	$3,582,000	$3,582,000	$3,582,000	$2,078,000
Unit Cost ($/acft)	-	-	$597	$597	$597	$346
Wastewater Reuse						
Supply From Plan Element (acft/yr)	-	-	-	5,000	5,000	5,000
Annual Cost ($/yr)	-	-	-	$1,630,000	$1,630,000	$1,630,000
Unit Cost ($/acft)	-	-	-	$326	$326	$326
Total New Supply (acft/yr)	0	6,000	12,000	17,000	17,000	17,000

5B.36.13 Manufacturing

5B.36.13.1 Water Supply and Demand

Manufacturing water use is projected to be 481 acft/yr in 2050, comprising about 0.4 percent of county-wide water M&I water use. These projections are reported from the 1997 Consensus State Water Plan and appear to be relatively low for the level of economic activity in Williamson County. Previously, the Trans-Texas Water Plan had projected 23,700 acft/yr of Manufacturing demand in the county by 2050. It would be prudent that each city in the county and the County-Other category plan accordingly for more Manufacturing water use than shown in the current projections in Table 4-71. To that end, the City of Round Rock's water plan has supply in it that could be used for Manufacturing use, as does the County-Other plan. The City of Georgetown's water plan recommends participation in the Little River Reservoir as a long-term option and that supply could be used for Manufacturing use if needed.

5B.36.14 Steam-Electric

There is no Steam-Electric demand or supply in Williamson County.

5B.36.15 Mining

The projections show a shortage of 1,543 acft/yr in 2030 for Williamson County Mining. The shortage is due largely, if not completely, to the conservatively low groundwater supply figures used for Williamson County. It is anticipated that Mining use will continue to be from locally available groundwater. If groundwater becomes unavailable due to drought or overpumpage, the Mining demand will either purchase new supplies from nearby water utilities, or will cease operation until groundwater levels (i.e., Edwards Aquifer) return. No water supply plan is proposed to meet projected Mining demands.

5B.36.16 Irrigation

No shortages are projected for Williamson County Irrigation and no changes in water supply are recommended.

5B.36.17 Livestock

No shortages are projected for Williamson County Livestock and no changes in water supply are recommended.

5B.37 Young County Water Supply Plan

Table 5B.37-1 lists each water user group in Young County and their corresponding surplus or shortage in years 2030 and 2050. For each water user group with a projected shortage, a water supply plan has been developed and is presented in the following subsections. Water supply plans are also presented for some entities that need pumping/conveyance facilities to utilize their existing water resources, or to become a regional provider. In addition, long-term considerations are provided for some entities with projected surpluses.

Table 5B.37-1.
Young County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	Surplus/(Shortage)[1] 2050 (acft/yr)	Comment
City of Graham	6,078	6,163	Projected surplus
City of Newcastle	0	0	Supply equals demand
County-Other	129	123	Projected surplus
Manufacturing	(223)	(299)	Projected shortage – see plan below
Steam-Electric	(3,500)	(3,500)	Projected shortage – see plan below
Mining	375	380	Projected surplus
Irrigation	(265)	(235)	Projected shortage – see plan below
Livestock	0	0	Supply equals demand

[1] From Tables 4-73 and 4-74, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.37.1 The City of Graham

The City of Graham obtains surface water from Lakes Graham and Eddleman. No future shortages are projected and no changes in water supply are recommended.

5B.37.2 The City of Newcastle

No future shortages are projected for the City of Newcastle and no changes in water supply uses are recommended.

5B.37.3 County-Other Category

No future shortages are projected and no changes in water supply uses are recommended.

5B.37.4 Manufacturing

5B.37.4.1 Description of Supply

Currently, there is no water supply categorized for Manufacturing use.

5B.37.4.2 Options Considered

Table 5B.37-2 lists the water management strategies, references to the report section discussing the strategy, total project cost, and unit costs that were considered for the Manufacturing category.

Table 5B.37-2.
Water Management Strategies Considered for Young County Manufacturing

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Voluntary redistribution from Municipal supply	223	$0	$0
South Bend Reservoir (Section 5A.14.2)	106,700	$205,000,000	$141
No Action	-	$39,929,000*	$179,053*

* Economic impact of not meeting shortage (i.e., “no action” alternative) in 2030 as estimated by TWDB.

5B.37.4.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the projected 2030 shortage of the Manufacturing category:

- Voluntary redistribution from Municipal Supply

The South Bend Reservoir has been recommended for consideration for long-term needs for the Brazos River Authority, as a major water provider, as described in Section 5B.38. The project is much too large to be pursued by any individual municipality, but if the BRA pursues it, this source should be considered by local entities.

5B.37.4.4 Costs

Costs of the Recommended Plan for Manufacturing:

a. Voluntary redistribution from Municipal Supply:
   - Cost Source: Estimated wholesale of $650/acft for treated water
   - Date to be Implemented: In place
   - Total Project Cost: $0

5B.37.5 Steam-Electric

5B.37.5.1 Description of Supply

Currently there is no water supply allocated to meet the Steam-Electric demand, which is from a TXU power plant on Lake Graham.

5B.37.5.2 Options Considered

During the public comment and review period, the consultant will be in contact with TXU and City of Graham to clarify under what water right this existing plant obtains its water supply.

5B.37.6 Mining

The water supply entities for Mining show a projected surplus. Therefore, no changes in the water supply system are recommended.

5B.37.7 Irrigation

5B.37.7.1 Description of Supply

Surface water supplies for Irrigation in Young County have been obtained from the Clear Fork of the Brazos, Salt Creek, and other small tributaries to these streams in the past. The estimated reliable supply of surface water for Irrigation is 143 acft until 2050. There are no significant groundwater supplies in the county.

5B.37.7.2 Options Considered

Table 5B.37-4 lists the water management strategies that were considered for Young County Irrigation shortages, and references the report section discussing the strategy, total project cost, and unit costs for meeting the shortage.

5B.37.7.3 Water Supply Plan

According to the Texas Agriculture Experiment Station, Young County has not practiced any significant irrigation in the past several years. Conversion to dryland production has occurred. Brush control and weather modification may be used to enhance dryland farming efficiency. The projected shortages for Irrigation are probably overstated, based on previous data.

Table 5B.37-3.
Water Management Strategies Considered for Young County Irrigation

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
Brush Control [1]	(*)	(*)	(*)
Weather Modification [2]	(*)	$500,000 to $850,000/yr	(*)
No Action	-	$38,000*	$144*

[1] Source of Cost Estimate: Section 5B.9.
[2] Source of Cost Estimate: Section 5B.1.
* Economic impact of not meeting shortage (i.e., "no action" alternative) in 2030 as estimated by TWDB.

5B.37.7.4 Costs

Costs of the Recommended Plan for irrigation supply are outlined in Table 5B.37-5. Costs for some options, such as brush control and weather modification, can not be directly quantified due to lack of specific data. Costs for these options have been estimated based on generally available data outlined in the corresponding chapter in Section 5B.

5B.37.8 Livestock

Livestock water use category shows no projected shortage and no changes in water supply are recommended.

Table 5B.37-4.
Recommended Plan Costs by Decade for the Young County Irrigation[1]

Plan Element	2000	2010	2020	2030	2040	2050
Brush Control						
Projected Shortage (acft/yr)	(313)	(296)	(280)	(265)	(250)	(235)
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Weather Modification[2]						
Supply from Plan Element (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Annual Cost ($/yr)	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000	$500,000 to $850,000
Unit Cost ($/acft)	(*)	(*)	(*)	(*)	(*)	(*)
Sum of Supply from Plan Elements (acft/yr)	(*)	(*)	(*)	(*)	(*)	(*)
Unmet Demands [3]	(313)	(296)	(280)	(265)	(250)	(235)

[1] Unless otherwise noted, costs are Total Project Cost and Unit Cost ($/acft per year) for water conserved through management practices. Unit cost is for full utilization of project capacity.
[2] Source of Cost Estimate: Section 5B.10.
[3] Projected shortages listed as unmet demands are probably overstated. Irrigation demand in Young County has been significantly reduced in recent years due to conversion to dryland farming.
* Definitive yield and/or cost cannot be determined.

5B.38 Major Water Providers

Table 5B.38-1 lists each major water provider in the Brazos G Region and their corresponding surplus or shortage in years 2030 and 2050. For each major water provider with a projected shortage, a water supply plan has been developed and is presented in the following subsections, or has previously been presented in their respective county section.

Table 5B.38-1.
Major Water Provider Surplus/(Shortage)

Water User Group	Surplus/(Shortage)[1] 2030 (acft/yr)	2050 (acft/yr)	Comment
Brazos River Authority	(90,259)	(202,014)	Shortage includes requests to BRA for additional water purchases
West Central Texas MWD	31,577	29,557	Supply using firm yield estimates; District maintains that safe yield estimates are more appropriate; also includes 15,000 acft/yr from O.H.Ivie Reservoir
City of Abilene	10,812	2,331	Includes customer city projected demands; 15,000 acft/yr supply from O.H. Ivie Reservoir
City of Waco	46,679	40,700	Includes contractual water supply commitments only
City of Round Rock	(6,695)	(16,122)	Includes full contracted water supply; infrastructure constraints not considered
Central Texas WSC	5,845	5,845	Includes contractual water supply commitments only
Bell County WCID No. 1	0	0	Includes contractual water supply commitments only
Lower Colorado River Authority	0	0	Includes contractual water supply commitments only; includes 25,000 acft/yr to BRA/LCRA Alliance

[1] From Tables 4-51 and 4-52, Section 4 – Comparison of Water Demands with Water Supplies to Determine Needs.

5B.38.1 Brazos River Authority

5B.38.1.1 Description of Supply

The Brazos River Authority is the primary provider of water to the Brazos G region. The BRA provides water from three wholly owned and operated reservoirs in the region: Lake Granbury, Possum Kingdom Lake, and Lake Limestone. BRA also contracts for conservation storage space in nine U.S. Army Corps of Engineers reservoirs in the region. BRA holds water rights in the region to divert 662,000 acft annually, and contracts to supply water to municipal, industrial, and agricultural water customers in the Brazos G region and other regions. Currently, BRA has a waiting list of requests from 35 entities wanting to purchase more than 235,000 acft/yr. Current supplies are almost fully committed and cannot meet the requested demands, resulting in a potential shortage of about 202,000 acft.

5B.38.1.2 Options Considered

Table 5B.38-2 lists the water management strategies, reports section references discussing the strategy, total project cost, and unit costs that were considered for meeting potential water needs of the Brazos River Authority.

Table 5B.38-2.
Water Management Strategies Considered for the Brazos River Authority

Option	Yield (acft/yr)	Approximate Cost	
		Total	Unit ($/acft)
System Operation	(1)	- -	- -
Development of Carrizo-Wilcox Groundwater Supplies (Section 5A.17)	65,000	$380,000,000	$699[2]
Millican Reservoir – Panther Creek Site (Section 5A.14)	235,200	$1,237,000,000	$366[3]
Millican Reservoir – Bundic Site (Section 5A.14)	73,800	$552,000,000	$541[3]
Little River Reservoir (Section 5A.14)	129,000	$361,000,000	$197[3]
Allens Creek Reservoir(4)	57,000 to 153,000	(5)	(5)
South Bend Reservoir (Section 5A.14)	106,700	$205,000,000	$141[3]
Caldwell Lake[6]	(5)	(5)	(5)
Whitney Reallocation (Section 5B.5)	54,500	$12,973,000	$57
Voluntary Redistribution (Section 5B.6)	178,000	n/a	$348 to $1,205
Control of Naturally Occurring Chlorides (Section 5B.8)	- -	up to $304,000,000	n/a
Conjunctive Use of the Brazos River Alluvium (Section 5B.19)	3,220	$9,843,000	$305
Purchase water from LCRA for use by BRA/LCRA Alliance	25,000	$86,614,000[7]	$597

1 Currently being estimated by BRA.
2 Treated water cost.
3 Raw water cost.
4 Located in Region H. Included in BRA Long Range Water Resource Development Program, 1995.
5 Not available at time of printing.
6 Included in BRA Long Range Water Resource Development Program, 1995. Not studied for Brazos G RWPA.
7 Total cost pro-rated from Table 5.16-8 for 25,000 acft project.

5B.38.1.3 Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet the potential needs of the Brazos River Authority in the 2000 to 2030 time period:

- Development of Carrizo-Wilcox Groundwater Supplies
- Millican Reservoir – Bundic Site
- Little River Reservoir
- Voluntary Redistribution
- System Operation
- Purchase of Water from LCRA for BRA/LCRA Alliance Use
- Control of Naturally Occurring Chlorides (Shallow well brine recovery with environmentally sound disposal. Environmentally sound disposal includes deep well injection or other methods that prevent the naturally occurring chlorides from entering the Brazos River. One such method is the harvesting of salt in the proposed Stonewall County Brine Utilization Management Project as described in Section 5A.8.)

In the long-term (i.e., beyond 2030), the Brazos River Authority is recommended to also pursue these projects to meet needs of the basin:

- Conjunctive Use of the Brazos River Alluvium
- South Bend Reservoir (Coordination with West Central Texas Municipal Water District regarding the development of Breckenridge Reservoir is needed. Hydrologic conditions of the area may not support the full development of both South Bend Reservoir and Breckenridge Reservoir.)

The Allens Creek Reservoir project is located in Region H (Houston Region). The Brazos G RWPG has not considered the Allens Creek Reservoir project and makes no recommendations regarding its utilization for Region H.

5B.38.1.4 Costs

The Brazos River Authority sponsors development of projects in response to needs in the basin and at the request of those needing the water. The BRA would not be the end user of the water. Most of the projects in the recommended plan are also included in the plans for other water user groups. For the following reasons, project costs and time schedules of costs is not summarized in this part of the plan, but is presented in the plans of the other water user groups:

- The timing of the projects is subject to obtaining requests for project implementation from users;
- The overall project yield and configuration is subject to number, demand, and location of project participants; and,
- The project costs and timing are listed within each user entities' recommended plans.

5B.38.2 West Central Texas Municipal Water District

The West Central Texas MWD (WCTMWD) is the primary water supplier to Abilene, Albany, Breckenridge, and Anson. The WCTMWD actively monitors regional needs and is progressive their planning and drought preparedness. The West Central Texas MWD can only obligate itself to provide the water specified in its customers contracts and it has a sufficient supply to meet those obligations. However, based on possible future economic upturns, new technologies, and new industries, WCTMWD is identifying regional water supply projects to benefit their service area. Projects to be included in the water plan would be identified and available to meet potential needs. To that end, the following projects are recommended to be included in the water plan for West Central Texas MWD:

a. Development of Seymour Aquifer groundwater supplies (this project is also in City of Abilene's recommended plan, but at a later implementation date):
   - Cost Source: Section 5A.12
   - Date to be Implemented: before 2010
   - Total Project Cost: $31,895,000
   - Total Annual Cost: $2,969,000
   - Project Yield: 11,100 acft/yr

b. Breckenridge Reservoir:
   - Cost Source: Section 5A.14
   - Date to be Implemented: beyond 2030
   - Total Project Cost: $171,000,000
   - Total Annual Cost: $12,589,000
   - Project Yield: 20,000 acft/yr
   - Coordination with Brazos River Authority regarding the development of South Bend Reservoir is needed. Hydrologic conditions of the area may not support the full development of both Breckenridge Reservoir and South Bend Reservoir.

Table 5B.38-3.
Recommended Plan Costs by Decade for West Central Texas MWD

Plan Element	2000	2010	2020	2030	2040	2050
Groundwater Development						
Supply from Plan Element (acft/yr)	- -	11,100	11,100	11,100	11,100	11,100
Annual Costs ($/acft)	- -	$2,969,000	$2,969,000	$2,969,000	$652,000	$652,000
Unit cost ($/acft)	- -	$267	$267	$267	$59	$59
Breckenridge Reservoir	- -					
Supply from Plan Element (acft/yr)	- -	- -	- -	20,000	20,000	20,000
Annual Costs ($/acft)	- -	- -	- -	$12,589,000	$12,589,000	$12,589,000
Unit cost ($/acft)	- -	- -	- -	$629	$629	$629

5B.38.3 City of Abilene (Major Water Provider)

The recommended water supply plan for the City of Abilene is included in Section 5B.33 with the Taylor County water user groups.

5B.38.4 City of Waco (Major Water Provider)

The recommended water supply plan for the City of Waco is included in Section 5B.24 with the McLennan County water user groups.

5B.38.5 City of Round Rock (Major Water Provider)

The recommended water supply plan for the City of Round Rock is included in Section 5B.36 with the Williamson County water user groups.

5B.38.6 Central Texas Water Supply Corporation

Central Texas WSC (CTWSC) is the primary water supplier to about 16 entities in Bell, Williamson, and Lampasas Counties. CTWSC can only obligate itself to provide the water specified in its customer contracts and it has a sufficient supply meet those obligations withno projected shortages. CTWSC is currently planning the extension of waterlines to the Salado WSC area in order to provide treatment and delivery of water that Salado WSC has purchased in Lake Stillhouse Hollow from BRA. The Salado WSC regional project is included in the recommended plan for Salado WSC in Section 5B.1 with the Bell County entities.

5B.38.7 Bell County WCID No. 1

Bell County WCID No. 1 (District) is the major water provider to Belton, Copperas Cove, Harker Heights, Killeen, and other entities in Bell County. The District can only obligate itself to provide the water specified in its customer contracts and it has sufficient supply to meet those obligations with no projected shortages. The District is in the planning stage of water treatment plant improvements, but has not indicated that any raw water or conveyance improvements are planned. No supply plans are currently recommended for Bell County WCID No. 1.

5B.38.8 Lower Colorado River Authority

In the Brazos G region, the Lower Colorado River Authority (LCRA) sells water to the City of Cedar Park, the City of Leander, and the City of Lometa. LCRA is only obligated to provide the water specified in its contracts, therefore, no shortages are shown for the LCRA in the planning region. Under the terms of HB 1437, LCRA can sell an additional 25,000 acft/yr to entities in Williamson County. The Brazos River Authority is negotiating with LCRA to purchase the 25,000 acft and distribute it to Williamson County under the BRA/LCRA Alliance. This supply is in the recommended plans for the City of Round Rock and for County-Other in Williamson County.

Section 6
Additional Recommendations

Each of the 16 regional water planning groups may make recommendations to the TWDB regarding legislative and regional policy recommendations; identification of sites uniquely suited for reservoirs; and, identification of unique ecological stream segments.

6.1 Legislative and Regional Policy Recommendations

The following regulatory, administrative, and legislative recommendations are made by the Brazos G Regional Water Planning Group to the Texas Water Development Board and to the Texas Legislature:

- Leave the planning process and the RWPGs in place for the next 5-year planning cycle;
- Recommend that the State pay all administrative costs in connection with the preparation of the regional water plan;
- Oppose the cancellation of existing water rights as a water management option:
- Support coordinated management of groundwater based on resource (i.e., aquifer) boundaries;
- Request that the Legislature give better definitions of “unique stream segment” and “unique reservoir site” and the ramifications of such designations;
- Recommend that the State devise a method (grant and loan) to pay for implementation of projects contained in approved regional plans;
- Expand existing loan/grant programs to assist agricultural interests in conserving and developing water, focusing on intensive brush controls in strategic groundwater areas;
- Delete the requirement in the rules for publication of notices in a “newspaper of general circulation” in each county in the Regional Water Planning Area for required public hearings;
- Recommend that “safe yield” as opposed to “firm yield” be used in the development of available water supply estimates for reservoirs, as appropriate;
- Encourage wastewater reuse as a water management option;
- Develop voluntary redistribution guidelines to encourage voluntary redistribution;
- Encourage regulatory agencies to assist local entities in implementing sound water quality enhancement projects to correct previously identified water quality problems in a timely manner; and
- Create incentives for industries to donate or deed water treatment and distribution facilities to governmental water suppliers.

6.2 Identification of Sites Uniquely Suited for Reservoirs

TWDB rules stipulate that reservoir sites within a planning region may be recommended by the RWPG for designation by the Texas Legislature as a segment of unique ecological value, provided specified criteria are met. Possible reservoir sites located in the Brazos G region were evaluated and reported to the RWPG (Refer to Section 5A.14, Volume 2). The sites evaluated were:

- Breckenridge Reservoir - Reynolds Bend Site
- South Bend Reservoir
- Paluxy Reservoir
- Lake Bosque
- Millican Reservoir – Panther Creek Site
- Millican Reservoir – Bundic Site
- Little River Reservoir

The evaluation indicated these reservoir are potential projects to meet the water supply needs of the region and of the Brazos River Basin. After careful consideration, the Brazos G RWPG passed a resolution to not recommend any sites as unique reservoir sites, stating there is not enough information currently available to determine the effects of such a designation. Until more specific guidance is provided, any action concerning recommendations of unique reservoir sites is deferred to the next planning cycle.

6.3 Identification of River and Stream Segments Meeting Criteria for Unique Ecological Value

Streams and rivers located within the Brazos G Regional Water Planning Area were evaluated to identify segments which meet criteria for unique ecological value according to the regional water planning guidelines (31 Texas Administrative Code, Section 357.8). This evaluation was described and documented in a draft report prepared for the Brazos G Regional Water Planning Group.[1] After careful consideration, the Brazos G RWPG passed a resolution to not recommend any rivers and streams as unique segments, stating there is not enough information currently available to determine the effects of such a designation.

[1] Hicks & Company, "River and Stream Segments of Unique Ecological Value in the Brazos G Regional Water Planning Area," Final Report Hicks & Company, August 2000.

Stream Segment Evaluation

The evaluation utilized existing water resource planning information and guidance provided by the Texas Parks and Wildlife Department, the U.S. Army Corps of Engineers, and Brazos River Authority to identify candidate stream segments. This information was supplemented with additional analyses that included evaluation of additional candidate stream segments (not identified by existing studies), utilization of historical and recently acquired satellite (Landsat) imagery, and field evaluations that included measurement of specific components of wildlife habitat. Segments were identified which met one or more of the following criteria specified by the planning guidelines:

I. Biological Function: A stream segment with significant overall habitat value defined by the following attributes:
   A. Quantity (acreage or areal extent of habitat)
   B. Quality
      1. Biodiversity (species richness of river, stream or riparian corridor.
      2. Age (age of stand of trees or a specific tree that is significantly old).
      3. Uniqueness (including but not limited to the following attributes).
         a. Undisturbed environment.
         b. Unusual or rare habitats.
         c. Rare species composition.

II. Hydrologic Function: A stream segment which is fringed by habitats that perform valuable hydrologic functions.
   A. Water quality.
   B. Flood attenuation and flow stabilization.
   C. Groundwater recharge and discharge.

III. Occurrence of Riparian Conservation Areas: Stream segments which are fringed by significant areas in public ownership, including state and federal refuges, wildlife management areas, preserves, parks, mitigation areas, or other areas held by governmental organizations for conservation purposes, or stream segments which are fringed by other areas managed for conservation purposes under a governmentally approved conservation plan.

IV. Occurrence of High Water Quality, Exceptional Aquatic Life, or High Aesthetic Value: Stream segments and spring resources that are significant due to unique or critical habitats and exceptional aquatic life uses dependent on or associated with high water quality.

V. Occurrence of threatened or endangered species, and/or unique communities: Sites along steams where water development projects would have significant detrimental effects on state or federally listed threatened or endangered species, and sites along streams which are significant due to the presence of unique, exemplary, or unusually extensive natural communities, such as old growth Beech-Magnolia stands and other rare natural communities.

Nineteen stream segments were identified which meet criteria for at least one or more categories of ecological significance as listed in the regional water planning guidelines (Table 6-1). Ten segments met the criteria for biological function, four qualified for hydrologic function, five met criteria for riparian conservation areas, nine qualified for designation as high water quality/exceptional aquatic life/high aesthetic value and four qualified according to the occurrence of threatened/endangered species or unique communities. Ten of the candidate sites qualified in more than one category, while three sites met criteria in at least three different categories. No single river or stream segment met all five criteria. The draft report contains additional descriptive information for these 19 sites, including photographs and location maps.

Table 6-1.
Summary of Significant Stream Segments

Stream Segment	***Counties***	***Biological Function (Rank)***	***Hydrologic Function***	***Riparian Cons. Area***	***High Water Quality/Aesthetic Value***	***Threatened and Endangered Species***
Brazos River*[1]	Bosque/Johnson/ Somervell/Hood	High diversity, old trees, increasing scarcity (9)			Aquatic Life/Aesthetics	
Brazos River*[1]	Palo Pinto	Moderate diversity, mature trees, increasing scarcity (10)			Aquatic Life/Aesthetics	Texas fawnsfoot (Rare, not listed)
Clear Fork Brazos River	Stephens	High diversity, old trees (3)				
Colony Creek*	Eastland	High diversity, old trees, unique, wetlands (7)			Ecoregion Stream, dissolved oxygen; benthic macroinvertebrates	
Colorado River*	Lampasas	White bass spawning area (8)			Aquatic Life/Aesthetics: Exceptional aesthetic beauty and value	Concho water snake (Fed. Threatened)
Cow Bayou*	Falls/McLennan				Ecoregion Stream, dissolved oxygen; benthic macroinvertebrates	
East & Middle Yegua Creek	Lee/Burleson		Flood attenuation, water quality, wetlands	Somerville WMA		
Lake Creek*	Grimes		Flood attenuation, aquifer recharge		Ecoregion Stream, dissolved oxygen; benthic macroinvertebrates	
Lampasas R.	Lampasas/Hamilton	High diversity, old trees (4)				
Leon River	Coryell/Bell	Moderate diversity, mature to old trees, size (2)		Mother Neff State Park & USACE lands		
Little River*	Milam/Bell					Rare freshwater mussels, thriving population
Navasota River	Brazos/Grimes/ Madison	High diversity, old trees, wetlands, size, increasing scarcity (1)	Flood attenuation, water quality, wetlands, aquifer recharge			
Navasota River	Robertson/Leon					Bald eagle (Fed. Threatened)
Neils Creek*	Bosque				Ecoregion Stream, dissolved oxygen; benthic macroinvertebrates	
North Bosque River	McLennan	High diversity, mature trees, size, increasing scarcity (5)	Flood attenuation, water quality, wetlands	Lake Waco, USACE lands/ WMA		
Nolan River	Johnson/Hill	High diversity, old trees, size, increasing scarcity (6)				
Paluxy River*	Somervell/Hood/ Erath			Dinosaur Valley State Park, a National Natural Landmark		
Steele Creek*	Bosque				Aquatic Life: Ecoregion Stream, dissolved oxygen; fish	
Willis Creek*	Williamson			Granger WMA	Ecoregion Stream; benthic macroinvertebrates	

* Designated by TPWD as Ecologically Significant.

[1] #1 Scenic/recreational river in northern half of Texas.

Source: TPWD unpublished data and web page: www.tpwd.state.tx.us/conserv/sb1/rivers/unique/region

Section 7
Plan Adoption

7.1 Public Involvement Program

The public involvement program was incorporated at the onset of the Brazos G regional water planning process in order to maximize the opportunity for public review and input into the process of developing the water plan as well as critique of the Initially Prepared Regional Water Plan.

The public involvement program included:

- The consultant team included a public involvement specialist
- Quarterly newsletters; dates of newsletters:
  1. March 1999
  2. July 1999
  3. October 1999
  4. March 2000
  5. July 2000
- Two series of public meetings held at four locations around the region:

August 2, 1999 at 10:00 a.m.
Granbury High School Auditorium
2000 W. Pearl Street
Granbury, Texas

August 2, 1999 at 7:00 p.m.
West Central Texas Council of Governments
1025 E. North 10th Street
Abilene, Texas

August 23, 1999 at 10:00 a.m.
Bell County Expo Center
301 S. Loop 121
Belton, Texas

August 24, 1999 at 7:00 p.m.
Brazos Center
3232 Briarcrest Drive
Bryan, Texas

August 7, 2000 at 10:00 a.m.
San Gabriel Community Park
Georgetown, Texas

August 8, 2000 at 1:30 p.m.
Hood County Annex #1
200 N. Gordon Street
Granbury, Texas

August 9, 2000 at 10:00 a.m.
Embassy Suite Hotel
4250 Ridgemont Drive
Abilene, Texas

August 10, 2000 at 10:00 a.m.
Brazos Center
3232 Briarcrest Drive
Bryan, Texas

Public Hearing
August 28, 2000 at 10:00 a.m.
Texas Farm Bureau Fleet Sales
5800 Franklin Avenue
Waco, Texas

- Press releases and notices of public meetings; and
- Dedicated website for Brazos G information.

7.2 Data Gathering and Coordination with Water Supply Entities

An initial informational mailout was prepared to all identified public water systems within the region. The mailout introduced the Senate Bill 1 water planning process to these systems and provided information on the planning process, the Brazos G Regional Water Planning Group, the means for obtaining public input, and a schedule of the major work tasks to be accomplished.

A survey was mailed to designated community water systems in the region (approx 460) to verify and augment existing data contained in the TNRCC database regarding population, number of water connections, water source, and interconnection with other systems. The survey included information regarding current water supply, water supply planning, growth projections and service area.

In order to obtain a sufficient number of responses from community water systems in the region, follow-up contacts of over 200 non-responsive systems were made in order to answer any questions and encourage completion of the survey and its return. For those systems that indicated the need, Texas Rural Water Association (TRWA) scheduled on-site visits with the system owner and/or manager.

7.2.1 Informational Mailouts to Water Supply Entities

<u>July 1998</u>

BRA Mailed an information request to community water supply systems to find out any concerns they may have about meeting customer water demands.

<u>September 11, 1998</u>

Letter from BGRWPG to water supply entities showing their population and water demand projections as compiled by TWDB and asking for their review.

<u>December 21, 1998</u>

Letter from BGRWPG to entities responding to September letter requesting TWDB-required information (*Guidelines and Data Requirements for Addressing Revisions of the Consensus-Based Population and Water Demand Projections*) to revise their respective projections.

March 25, 1999

TRWA mailed approximately 460 draft water demand projections for community water systems through year 2050. Asked for their review and comments if necessary and include supporting information (i.e., engineering studies).

April 29, 1999

TRWA summarized survey results to HDR:

- 77 utilities in 28 counties responded to letter of March 25, 1999
- Follow-up calls concentrated on larger water utilities in each county

May 1999

TRWA made over 200 follow-up phone calls to community water systems that had not responded to survey letter and request.

- 170± municipalities petitioned for changes to their population and water demands.

August 1999

TWDB required additional information to substantiate requested revisions to population and water demands – TRWA/HDR made contacts for additional information.

March 17, 2000

BGRWPG mailed letter to each county with draft interim report data regarding that county's water suppliers for their review and comment and any information they could supply back.

7.2.2 Brazos G Regional Water Planning Group Meetings

The Brazos G Regional Water Planning Group met approximately once every month since the inception of the planning process in order to facilitate and direct the water planning for the region.

7.3 Coordination with Other Regions

Prime consultant has attended several meetings with the Region H consultant and has exchanged information on surface water supply and water management strategies. Special Water Resource tables have been developed for reservoirs that supply water into or out of Region G and these tables have been reviewed with the adjoining regions.

Consultant presented a detailed briefing to a joint meeting of Region G and Region K.