

## 3.2 REGIONAL PERSPECTIVE

While Chapter 16.051 of the Texas Water Code requires evaluation and planning along river basin boundaries, most of the State's river basins cover vast geographic expanses, extending from one end of the State to the other. The Brazos River Basin, for instance, includes portions of 74 counties stretching from the Texas Panhandle to the Gulf Coast, and encompasses a wide range of socio-economic, climatological, hydrologic, and physiographic characteristics.

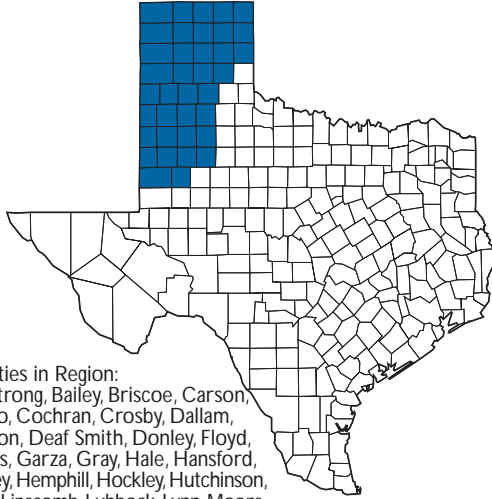
There is no optimal method of drawing regional water planning boundaries. Our river (and watershed) basin boundaries mostly run diagonally across the State, while major and minor aquifers, in many instances, run perpendicular to the surface water basins. Socioeconomic and utility development patterns are not constrained by water resource boundaries and often overlap them. The regional planning boundaries (shown in 2-2, page 2-10) have been developed by Board staff after many years of professional debate and public comment. These boundaries reasonably "package" common water problem areas into regional study units.

Most water-related problems as well as opportunities for action take place at the local or regional level rather than at the river basin level. In order to be responsive to water problems and needs of diverse regions, the State Water Plan developed analyses for 16 planning regions. It is a goal of the State Water Plan to provide analyses along regional boundaries to help promote unified, efficient, and coordinated planning of the state's water resources.

The following regional analyses include historical and projected economic, demographic, and water use information, as well as a discussion of regional and local water-related problems, needs and recommended solutions. To highlight important trends in water use characteristics, regional population and water use statistics are presented in comparison to the state as a whole, and in comparison with population and water use changes over time.

# Panhandle Region

## Location Of Region



Counties in Region:  
 Armstrong, Bailey, Briscoe, Carson,  
 Castro, Cochran, Crosby, Dallam,  
 Dawson, Deaf Smith, Donley, Floyd,  
 Gaines, Garza, Gray, Hale, Hansford,  
 Hartley, Hemphill, Hockley, Hutchinson,  
 Lamb, Lipscomb, Lubbock, Lynn, Moore,  
 Ochiltrie, Oldham, Parmer, Potter,  
 Randall, Roberts, Sherman,  
 Swisher, Terry, Wheeler, Yoakum

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Lubbock	194,349	271,152
• Amarillo	167,548	286,692
• Plainview	21,632	22,981
• Pampa	19,810	19,597

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Petroleum Refining
- Food & Kindred
- Chem. & Allied Products
- Textile Mill Products

### Major Irrigated Crops

- Cotton
- Wheat
- Corn
- Sorghum

**Figure 3-18**

## Historical and Projected Population and Water Use

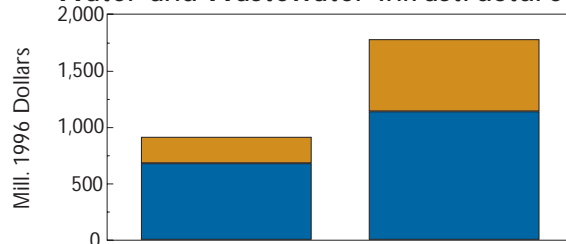
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	744,722	884,401	993,966	1,083,830	45.5%
% of State Total	4.38%	3.76%	3.24%	2.96%	-----
Municipal Water Use	153,421	170,228	178,177	190,310	24.0%
Industrial Water Use/1	80,931	100,254	120,342	136,252	68.4%
Agricultural Water Use/2	5,508,402	5,197,617	4,875,696	4,579,066	-16.9%
Irrigation Adjustment /3	0	(517,818)	(2,000,707)	(2,709,145)	-67.5%
Total Water Use (ac-ft)	5,742,754	4,950,281	3,173,508	2,196,483	-61.7%
% of State Total	36.51%	31.27%	21.50%	14.73%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Amarillo	44,374	62,621
Borger	2,387	1,868
Lubbock	38,394	44,041
Plainview	4,505	3,930
Pampa	4,003	3,227

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$679.5	\$1,139.9
Wastewater	\$237.7	\$640.9
Total	\$917.2	\$1,780.8

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.1 Panhandle Region

**Regional Description.** The Panhandle region is comprised of 37 counties located in the Canadian River Basin and in portions of the Colorado, Brazos, and Red basins. In 1980, the region had a total population of 748,915. By 1990, the region lost .6 percent of its population, for a total of 744,722. Although this declining trend has reversed in recent years, the region is expected to experience relatively slow population growth in the coming decades. By 2050, the region is projected to reach about 1.1 million people, an increase of 46 percent over the 1990 population.

The Panhandle region is the largest water-consuming region in the State. In 1990, the region accounted for only 4.4 percent of the State's total population, but accounted for nearly 37 percent of the State's annual water use. Total water use in the region was approximately 5.7 million acre-feet, with water used for agriculture accounting for 96 percent. Total water use for the region is anticipated to decline by about 62 percent over the 1990-2050 period. This anticipated reduction in total water use is due primarily to expected reductions in irrigation water requirements. The reduction in irrigation water requirements is predominately associated with estimated insufficient quantities of groundwater to meet current and projected water demands for irrigation purposes combined with anticipated use of more water use efficient irrigation technology. The planning scenario in the Consensus Water Plan estimates that conversion to more efficient irrigation technology could save more than 337,000 acre-feet by 2050. Although the population is projected to increase 46 percent from 1990 to 2050, municipal water use is projected to increase only 24 percent. The implementation of municipal water conservation programs and practices under the planning scenario is responsible for the slower rate of increase, and is projected to save 28,000 acre-feet by 2020, and 42,000 acre-feet by 2050. Conservation measures incorporated in the municipal, agricultural, and manufacturing planning scenarios are projected to save approximately 218,000 acre-feet by 2020 and 393,000 acre-feet by 2050 over scenarios that do not incorporate conservation practices.

**Regional Water-related Problems and Needs.** The Ogallala (High Plains) Aquifer is the major source of municipal and irrigation water for the region. Currently, the aquifer supplies irrigation water to about 4.0 million acres. Since the expansion of irrigated agriculture in the mid 1940s, greater amounts of water have been pumped from the aquifer than have been recharged. As a result, heavily irrigated areas have experienced water-level declines, some in excess of 100 feet. Reduced pumpage in other areas has resulted in a reduction of water-level declines and, in some cases, water-level increases.

Some ground-water contamination from past oil field practices has occurred mostly in the Southern High Plains. Dissolved-solids concentrations in excess of 3,000 mg/l suggest that the greatest cause of contamination was by oil field brines, particularly the disposal of oil-field brines into unlined surface pits prior to the statewide "no pit" order of the Railroad Commission. Likely, much of the water discharged into these pits seeped into the ground and eventually into the ground-water system. Additional brine contamination may be resulting from abandoned oil, gas, injection wells, and wells with broken or poorly cemented casings.

Surface water resources of the region are limited. Studies conducted by the Canadian River Municipal Water Authority have reduced the estimated water supply available from Lake Meredith to about 70% of the original permitted amount. In addition to reduced water availability, Lake Meredith also has water quality problems. In order to maintain the continued suitability of water from the lake for municipal and manufacturing purposes, the Bureau of Reclamation and the Canadian River Municipal Water Authority are jointly funding and developing a salinity control project near Logan, New Mexico. Although some difficulties have been experienced with the project, actual construction is slated to begin in early 1998.

Concerns over the possibility of some type of ground-water pumpage restrictions or required maintenance of streamflow due to the proposed listing of the Arkansas River shiner as an endangered specie have been voiced in several public meetings in the region by local citizens. No action on this proposal has been taken to-date.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Underground Water Conservation Districts.** Districts have played a significant role in the management of the water resources of the region. By 1955, five districts had been established on the High Plains ranging in size from small parts of single counties to multi-county districts. Nine districts are currently in operation and some districts have expanded to include additional territory. Currently active underground water conservation districts include: Dallam County #1, High Plains #1, Mesa, North Plains #2, Panhandle #3, Sandy Land, and South Plains. In addition, the Garza County district was created in 1996. Most of these districts maintain well spacing rules to control density of pumping wells and have an extensive water-quality and water-level monitoring network. A majority of the districts have production regulation rules, and one district has a depletion rule. All of the above-mentioned districts, except Garza, have submitted comprehensive management plans to TNRCC.

**Canadian River Municipal Water Authority (CRMWA).** CRMWA owns and operates Lake Meredith. The Authority provides water to Borger and Pampa in the Canadian Basin; Amarillo in the Red River Basin; Lubbock, Levelland, Slaton, Plainview, Tahoka, and O'Donnell in the Brazos River Basin; and Brownfield and Lamesa in the Colorado River Basin. Studies conducted by the Authority have reduced the estimated water supply available from Lake Meredith to about 70% of the original permitted amount. The Authority is developing a well field in Roberts County to supply approximately 40,000 acre-feet of groundwater to supplement the water from Lake Meredith.

**Palo Duro River Authority (PDRA).** The Authority owns and operates Lake Palo Duro for its member cities of Gruver, Spearman, Sunray, Stinnett, Dumas and Cactus. Distribution lines to all the member cities are planned for future development.

**White River Municipal Water District (WRMWD).** The District owns and operates White River Reservoir, from which the District's water right authorizes the diversion of up to 6,000 acre-feet of water per year for municipal and mining purposes. The District serves cities and communities in Garza, Crosby, Dickens, Kent and Lubbock counties.

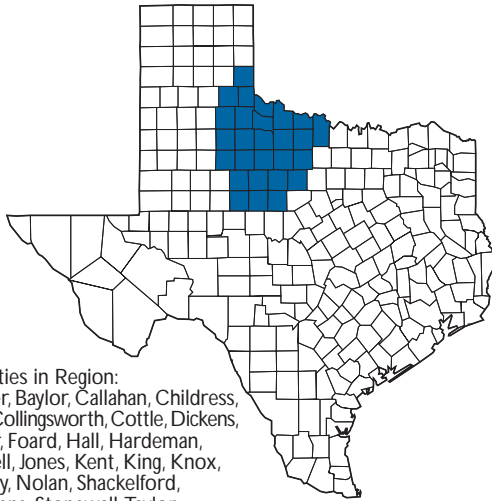
**Amarillo.** The City is supplied water by CRMWA and its own well fields in Carson, Deaf Smith, and Randall counties. The City will continue to rely on these sources to meet its future needs. If the water supplies from the well fields are limited by groundwater management policies of the Panhandle Underground Water Conservation District, then the City could develop additional ground-water resources in Hartley County.

**Lubbock.** The City is supplied water by CRMWA and its own well fields in Bailey and Lubbock counties. Lubbock will continue to rely on surface water from CRMWA, and groundwater from CRMWA's new Roberts County well field and the City's own well fields to meet its future needs. The City also has water rights to Alan Henry Reservoir. The reservoir will be needed by the City to meet its needs by 2030.

**Borger.** The City will continue to be supplied by CRMWA from Lake Meredith and the new Roberts County well field.

# Rolling Plains Region

## Location Of Region



Counties in Region:  
 Archer, Baylor, Callahan, Childress,  
 Clay, Collingsworth, Cottle, Dickens,  
 Fisher, Foard, Hall, Hardeman,  
 Haskell, Jones, Kent, King, Knox,  
 Motley, Nolan, Shackelford,  
 Stephens, Stonewall, Taylor,  
 Throckmorton, Wichita, Wilbarger,  
 Young

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Abilene	115,293	169,375
• Wichita Falls	98,107	119,143
• Vernon	12,460	13,576
• Sweetwater	11,906	12,297

/1 State Data Center /2 TWDB

### Major Water-Using Industries

- Stone, Clay & Glass
- Food & Kindred
- Fabricated Metal Products

### Major Irrigated Crops

- Cotton
- Wheat
- Peanuts
- Hay

Figure 3-19

## Historical and Projected Population and Water Use

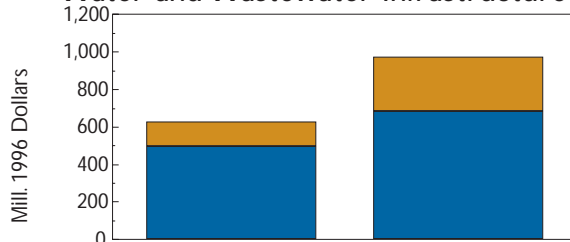
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	403,545	449,455	476,489	484,726	20.1%
% of State Total	2.38%	1.91%	1.55%	1.32%	-----
Municipal Water Use	80,370	92,252	91,937	91,461	13.8%
Industrial Water Use/1	26,120	27,978	32,869	33,928	29.9%
Agricultural Water Use/2	204,406	195,761	185,121	174,976	-14.4%
Irrigation Adjustment /3	0	(4,432)	(13,401)	(13,335)	-25.0%
Total Water Use (ac-ft)	310,896	311,559	296,526	287,030	-7.7%
% of State Total	1.98%	1.97%	2.01%	1.92%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Abilene	27,003	33,581
Wichita Falls	21,699	22,154
Vernon	2,694	2,494
Sweetwater	3,914	3,512
Burkburnett	1,839	1,815

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$498.7	\$682.8
Wastewater	\$129.7	\$291.1
Total	\$628.4	\$973.9

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.2 Rolling Plains Region

**Regional Description.** The Rolling Plains region consists of 27 counties in portions of the Red, Brazos, and Colorado River basins. In 1980, the population of the region was 407,383, declining slightly to 403,545 by 1990. The regional population is projected to reach approximately 485,000 by 2050, an increase of 20 percent over the planning period.

In 1990, total water use for the region was about 311,000 acre-feet, and accounted for 2 percent of the State's total water use. Agriculture was the largest water use category in the region, accounting for almost 66 percent of the region's water use. With the exception of water for irrigation, water use in all other categories is projected to increase over the planning period. Municipal water use is projected to increase almost 14 percent, while industrial water use is projected to increase about 30 percent. Although these categories anticipate greater water use, the net use for the region is expected to decline about 8 percent as the reduction in irrigation water use offsets increases in other uses. The anticipated reduction in irrigation water use is due primarily to estimated insufficient quantities of groundwater to meet current and projected irrigation water demands, combined with an expected increase in the use of more water-efficient irrigation technology. By 2020, it is projected that conservation measures incorporated into the municipal, manufacturing, and irrigation water use planning scenario could save approximately 19,000 acre-feet of water. By 2050, conservation is projected to save approximately 29,000 acre-feet.

**Regional Water-related Problems and Needs.** Natural salt pollution in the middle Red River Basin precludes the full utilization of the water resources of the region. To reduce the natural salt pollution, it is recommended that the federal chloride control project (Crowell Brine Lake) continue to be funded and operated. Natural salt pollution in the upper reaches of the Brazos River Basin reduces the ability of water supplies to be used without expensive treatment or precludes the use of this water resource altogether. It is recommended that the Brazos River Chloride Control projects (Kiowa Peak, Dove, and Croton Brine Lakes) also be constructed, if determined to be feasible, to reduce the salinity in downstream water supplies. Another, less expensive option would involve a system of shallow recovery wells to reduce the piezometric head on the saline aquifer and injection of the recovered brine into deep wells. Computer simulations for this approach appear promising and field testing to verify the modeling assumptions is recommended as the next research phase.

The region has recently experienced droughts more severe than those used to estimate available supplies in the permitting process. The more severe droughts have reduced the supply availability estimates for the White River District and the City of Wichita Falls. Sedimentation of reservoirs has also reduced the available supplies in a number of reservoirs. The build-up of sediment near the intakes of Lake Stamford has caused the City of Stamford not to be able to deliver water at times.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described

below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Colorado River Municipal Water District (CRMWD).** Initially, the geographical boundaries of the CRMWD consisted of the District's three member (Odessa, Big Spring, and Snyder) cities' municipal limits. An amendment in 1981 included a second jurisdictional boundary encompassing the drainage area of the Colorado River above the east county line of Coleman County. This boundary encompassed all or part of thirty-four counties. In addition, the counties of Ector, Ward, Winkler, Loving, Reeves, and Culberson were added by the amendment to the jurisdiction of the CRMWD. The CRMWD owns and operates four reservoirs (Lakes J.B. Thomas, E.V. Spence, Moss Creek, and Ivie) used for water supply, and five reservoirs used for water quality enhancement. The District also operates two ground-water well fields, one in Ward County and one in Martin County.

**Brazos River Authority (BRA).** BRA's duties include management of flood control operations; private sewerage licensing programs; operation of wastewater treatment plants and associated lines, including four regional wastewater systems; operation of a regional water treatment system; supply and conservation of water in lakes with a combined total conservation storage capacity of over 2.1 million ac-ft.; collection of streamflow data; operation of pollution control programs; and generation of electricity. The lakes owned and operated by BRA are Granbury, Limestone, Alan Henry, and Possum Kingdom; the latter also generates hydropower as well as supplying water. Lakes owned by the U.S. Army COE are Waco, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Somerville, Whitney and Aquilla. Water from reservoir storage not committed to local use is used to meet needs in other parts of the Basin (or in other basins) under BRA's plan for system operation.

**North Central Texas Municipal Water Authority (NCTMWA).** The Authority serves the cities of Goree, Knox City, Munday and Haskell via its water right authorization to divert up to 5,000 ac-ft of water per year from Millers Creek Reservoir in Baylor County for municipal, industrial and mining purposes.

**White River Municipal Water District (WRMWD).** WRMWD owns and operates White River Reservoir, from which the District's water right authorizes the diversion of up to 6,000 ac-ft of water per year for municipal and mining purposes. The District serves cities and communities in Garza, Crosby, Dickens, Kent and Lubbock counties. The District also has a permit for Post Reservoir; however, the project is not recommend for development during the planning horizon. The District is investigating use of the Ogallala Aquifer to supplement the supply in White River Reservoir.

**West Central Texas Municipal Water District (WCTMWD).** WCTMWD holds water rights in Hubbard Creek Reservoir that authorize it to divert up to 56,000 ac-ft of water per year from the reservoir for municipal, industrial, irrigation, mining, and domestic and livestock use. The District provides raw water to its member cities of Abilene, Albany, Anson and Breckenridge. It holds a long-term contract with CRMWD for 16 percent of water stored in



Ivie Reservoir and a supporting contract with the City of Abilene to provide this water to the City.

**Abilene.** The City relies on lakes Fort Phantom Hill, Kirby, and Abilene and water from WCTMWD to meet its needs. The City also has a contract with WCTMWD for its 16 percent of Ivie Reservoir, and will have to build a pipeline to Ivie by 2025 to meet its projected needs. The pipeline could be constructed sooner if the City becomes a larger regional water supplier.

**Hamlin.** The City is supplied raw water from Lake Stamford by the City of Stamford. However, TWDB estimates indicate that Lake Stamford will not be able to supply the needs of both cities for the planning horizon. It is recommend that the City participate in a regional system that would be supplied water from Lake Hubbard and then from Lake Ivie when the pipeline from Abilene is built.

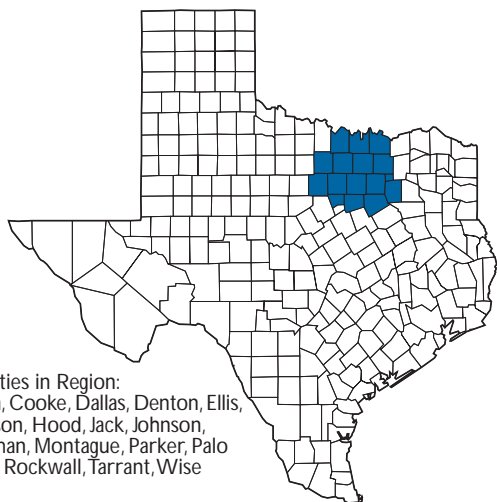
**Stamford.** The City obtains raw water from Lake Stamford, which has experienced problems with sediment build-up near the City's water supply intakes. It is estimated that the lake would not be able to supply the needs of both Stamford and Hamlin through the planning horizon, thus it is recommended that the City obtain water from either WCTMWD or Abilene.

**Sweetwater.** The City's primary water source is Oak Creek Reservoir, with lesser amounts from lakes Trammel and Sweetwater. The City also receives groundwater from a well field under contract. Depending on the production from the well field, the City could use water from Abilene once the Ivie pipeline is completed.

**Wichita Falls.** The City's two supply sources, lakes Kickapoo and Arrowhead were recently evaluated for their water supply availability. The supply estimate for the two-lake system was about 45,600 acre-feet, which is 39,000 acre-feet less than the permitted total from the two projects. However, using TWDB's estimate of needs for the City and its customers, there should be adequate supplies to meet its water needs for the planning horizon. If additional water supplies do become needed due to reservoir sedimentation or other reasons, the recommended Federal chloride control project, Crowell Brine Lake and diversion facilities, could make available water supplies from Lake Kemp more potable for the City's future use.

# North Central Texas Region

## Location Of Region



Counties in Region:  
Collin, Cooke, Dallas, Denton, Ellis,  
Grayson, Hood, Jack, Johnson,  
Kaufman, Montague, Parker, Palo  
Pinto, Rockwall, Tarrant, Wise

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Dallas	1,048,882	1,266,225
• Fort Worth	473,291	645,074
• Arlington	286,545	413,986
• Garland	189,816	217,564
• Irving	169,265	279,929

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Transportation Equip.
- Food and Kindred
- Electronic & Other Equip.
- Stone, Clay & Glass

### Major Irrigated Crops

- Pecans
- Peanuts
- Hay
- Alfalfa

Figure 3-20

## Historical and Projected Population and Water Use

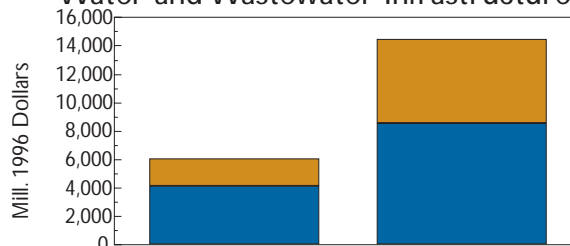
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	4,124,183	5,726,911	7,485,748	9,046,600	119.4%
% of State Total	24.28%	24.38%	24.40%	24.67%	-----
Municipal Water Use	848,437	1,192,786	1,376,184	1,632,599	92.4%
Industrial Water Use/1	137,515	180,310	215,615	263,552	91.7%
Agricultural Water Use/2	30,132	31,067	30,938	30,842	2.4%
Irrigation Adjustment /3	0	0	0	0	-----
Total Water Use (ac-ft)	1,016,084	1,404,163	1,622,737	1,926,993	89.6%
% of State Total	6.46%	8.87%	10.99%	12.92%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Dallas	313,668	353,170
Fort Worth	112,370	127,788
Denton	18,220	26,875
Irving	46,989	61,771
Waxahachie	5,634	8,157
Sherman	5,010	4,679
Denison	4,113	3,575

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$4,106.6	\$8,564.0
Wastewater	\$1,988.0	\$5,897.4
Total	\$6,094.6	\$14,461.4

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.3 North Central Texas Region

**Regional Description.** The North Central Texas Region consists of 16 counties located in portions of the Red, Brazos, Trinity, and Sabine River basins. As the most populous region in the State, North Central Texas contains approximately one quarter of the State's population. From 1980 to 1990, the population grew from 3.14 million to 4.12 million, a 31 percent increase. Rapid growth is anticipated for the region's future as population is projected to increase 119 percent by 2050 to reach nearly 9 million.

While the region makes up 24 percent of the State's population, it accounts for approximately 6 percent of State's annual water use. From 1990 to 2050, total water use in the region is expected to increase almost 90 percent from about 1.02 million acre-feet in 1990 to about 1.93 million acre-feet by 2050. Municipal is the largest water use category in the region, using more than 848,000 acre feet, or 84 percent of region's total water used in 1990. With continued population growth, municipal water use is anticipated to increase more than 92 percent over the 1990-2050 planning period. Water use by industry is also anticipated to increase rapidly.

By 2020, conservation practices incorporated into the municipal, manufacturing, and irrigation planning scenarios are projected to save approximately 263,000 acre-feet over scenarios with no conservation. By 2050, these savings could amount to approximately 465,000 acre-feet. Most of the water savings are expected to come from conservation efforts in the municipal sector. Such efforts include using more efficient plumbing fixtures, improved leak detection, and improved residential outside watering practices.

**Regional Water-related Problems and Needs.** Ground-water levels in the Trinity Aquifer have been lowered severely in the area due to prolonged usage, resulting in increasingly high pumping costs. In addition, the quality of groundwater has been deteriorating as water levels have declined. Surface water quality suffers from high urban use pressures including urban runoff and wastewater treatment plant discharge (problems related to dissolved oxygen content, suspended solids, phosphates, fecal coliform, algal blooms, and aquatic plants), and runoff from agricultural areas. High chloride concentrations in Lake Texoma preclude full utilization of this water resource. Surface water development is near the maximum potential for the Upper Trinity River Basin and water is being imported from neighboring basins to the east. Regional initiatives to address watershed management and water conservation are underway in the Upper Trinity Basin.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Tarrant Regional Water District (formerly Tarrant County Water Control and Improvement District #1).** The District (TRWD) presently owns and operates four reservoirs: Eagle Mountain, Bridgeport, Cedar Creek, and Richland-Chambers, and has storage rights

in Benbrook Reservoir. The District provides raw water to the cities of Arlington, Mansfield, and Fort Worth which in turn provide treated water to most of the cities in Tarrant County. TRWD also currently provides water and has contracts to sell additional future water to entities in Parker, Ellis, Wise, Jack, Henderson, and Kaufman counties. The District also provides water to the Trinity River Authority, which then sells treated water to the cities of Bedford, Euless, North Richland Hills, Grapevine, Colleyville, and several other small communities and water supply corporations. In addition, the District will augment the raw water supplies of Weatherford and Benbrook in the future. The development of additional supplies by the District will be required by the year 2030 in order to meet its customers' needs. Recommended projects include the diversion of Trinity River (wastewater) return flow from the Fort Worth area into the District's lower reservoirs, Richland-Chambers and Cedar Creek, anticipated during the 2025 to 2030 time period, and the eventual construction of the Tehuacana Reservoir project for use by the year 2050. The District began developing a pilot scale constructed wetlands facility adjacent to Richland Chambers Reservoir in 1992. The next anticipated phase of the reuse project is a 200 acre component of constructed wetlands, upon issuance of a permit by the TNRCC. If the Trinity River reuse project is proven infeasible, sufficient supplies could be obtained from the recommended Nichols I Reservoir project located in the Sulphur River Basin. Construction of this project may depend on regional cooperation and/or resolving land-use conflicts.

**North Texas Municipal Water District (NTMWD).** The NTMWD currently provides approximately 180,000 acre-feet of water per year, supplying the water needs of nearly one million people in a service area which covers over 1,600 square miles. Supply sources for the District include three reservoirs, Lavon, Texoma and Cooper. The development of additional supplies and conveyance systems will be required by the year 2015 to meet demands by the District's member cities. Recommended projects include the construction of Parkhouse II Reservoir in the Sulphur River Basin and associated conveyances by the year 2015. The Nichols I Reservoir project, if constructed early and depending upon regional cooperation, could offset the need for the Parkhouse II Reservoir. If the Red River Chloride Control Project successfully increases the quantity of usable water supplies in Lake Texoma, then the reallocation and permitting of the unappropriated portion of Texas' share of Lake Texoma waters is recommended by 2050 in order to provide additional supplies to the District. This will also necessitate the construction of a new conveyance system to transport the additional water.

The District owns and/or operates more than a dozen regional and subregional wastewater treatment and conveyance facilities in Collin, Dallas and Rockwall counties. Plano, McKinney, Mesquite and Rockwall are just a few of the cities served by these facilities. Growth in the area has led to expansion and upgrades to several of the plants serving the area over the last few years.

**Dallas Water Utilities.** Dallas Water Utilities (DWU) provides treated and raw water to over 30 municipalities and water supply corporations in Dallas, Denton and Collin counties. Water supplies for DWU are available from seven surface water reservoirs; Grapevine, Lewisville, Ray Roberts, Tawakoni, Ray Hubbard, Palestine, and Fork (transmission facilities are not yet constructed to Lake Palestine and Lake Fork). Total available supply to DWU is over 650,000 acre-feet. Projections for DWU include construction of transmission facilities from Lake Palestine to

Dallas by about year 2015, and from Lake Fork to Dallas by 2005. Other recommended projects include the construction of the Nichols I Reservoir which is expected to be needed by DWU customers by 2040. The City is currently examining the feasibility of other water supply projects and alternatives such as expanded reuse of treated effluent for supplementing the DWU existing water supplies.

DWU also operates two of the largest wastewater treatment facilities in Texas, the Dallas Central Plant with a 150 MGD treatment capacity, and the Southside Plant with a 90 MGD treatment capacity. Both plants have recently undergone extensive upgrading and modernization programs. The City also maintains a collection system that transports wastewater to a treatment facility operated by the Trinity River Authority.

**Trinity River Authority (TRA).** The Trinity River Authority is the local sponsor of Joe Pool Reservoir and provides water to the Midlothian Water District. The TRA provides water to the cities of Corsicana, Waxahachie and other Ellis County communities through Lake Bardwell and Navarro Mills Reservoir. In addition, the TRA provides water to the cities of Bedford, Euless, North Richland Hills, Grapevine, and Colleyville through its contract with the TRWD.

The TRA is the State's largest operator of regional wastewater treatment works. The Central Plant (135 MGD capacity) and interceptor system serves 19 cities in the "mid-cities" area of Dallas and Tarrant counties, including portions of Fort Worth, Dallas, and D/FW Airport. In addition, the Ten Mile Creek Regional System (permitted capacity of 24 MGD) and the Red Oak Creek Regional System serve 12 cities in the Dallas and Ellis county area, and the Denton Creek Regional System serves another 5 cities and two Municipal Utility Districts, located in southern Denton County.

**Upper Trinity Regional Water District (UTRWD).** The Upper Trinity Regional Water District was created in 1989 to provide regional water and wastewater services for the Denton County area which is anticipated to be one of the fastest growing population areas in the State. The service area for the District, which includes nearly all of Denton County and a portion of Collin County, is within the water supply planning boundaries of the City of Dallas Water Utilities. Since Dallas has planned future water supplies for the majority of Denton County, the District obtains a substantial portion of its water supply from Dallas Water Utilities out of Lake Lewisville. In addition, the District also contracts with the City of Commerce for a water supply out of Cooper Reservoir in the Sulphur River Basin and is cooperating with the City of Irving and NTMWD in the joint development of transmission facilities. Using \$61 million in financial assistance from TWDB, the District, since 1992, has developed a regional water system to treat and deliver water to 12 cities with expansion capability to serve 25 cities. For future water supplies, the District plans to rely on water resources developed by the Dallas Water Utilities, and to cooperate with other regional entities in the development of the Nichols and Parkhouse II reservoir projects.

In 1996, Lake Cities Municipal Utility Authority transferred ownership of its wastewater treatment plant to the Upper Trinity Regional Water District. The District is expanding the plant from its current capacity of 1.038 MGD to 4.5 MGD, and plans to construct approximately four miles

of wastewater force mains, two lift stations, and two miles of gravity sewer lines. The plant will serve as a regional wastewater collection and treatment system for the City of Highland Village, Lake Cities Municipal Utility Authority, the southeastern half of the City of Corinth, and possibly other cities in the area.

**Fort Worth.** The City of Fort Worth obtains raw water from the TRWD. The City owns and operates four water treatment plants; the North Holly, South Holly, Rolling Hills, and Eagle Mountain which provide treated water to more than 20 cities in Tarrant County. Combined treatment capacity is nearly 300 MGD and is adequate to meet the water needs of the City and all of its wholesale water customers through at least the year 2020.

Since the early 1990's, the City of Fort Worth has received over \$90 million in State Revolving Fund (SRF) loan commitments for wastewater treatment improvements. Some of the projects funded have included expansion and upgrades to the City's Village Creek Wastewater Treatment Plant, which serves Fort Worth and 24 neighboring communities in Tarrant and Johnson counties. The Village Creek plant recently underwent expansion from 120 MGD to a new treatment capacity of 144 MGD.

**Greater Texoma Water Authority (GTWA).** The GTWA has rights to about 70,000 acre-feet of water per year in Lake Texoma. GTWA has developed diversion facilities in conjunction with NTMWD, and provides water to the Sherman-Denison area.

**Sherman-Denison.** Since the completion of diversion and treatment facilities by the GTWA, the City of Sherman's water needs are being met from a combination of groundwater from the Trinity Aquifer and surface water from Lake Texoma. The City of Denison obtains groundwater from wells completed in the Woodbine Aquifer, and surface water from Lake Randall and Lake Texoma. Both cities plan to continue to use these supply sources through the foreseeable future, and projections indicate that future water needs will be met through the year 2050.

The Post Oak Creek wastewater treatment plant serves the City of Sherman. It has recently been expanded from a 12 MGD capacity to 16 MGD. The City of Denison operates two wastewater treatment facilities. The Paw Paw Creek WWTP has a capacity of 6 MGD and the Airport WWTP has a capacity of 0.4 MGD. Two pre-existing treatment facilities were consolidated into the Paw Paw Creek Plant.

**Denton.** The City of Denton currently obtains surface water from Lake Lewisville, Lake Ray Roberts, and from the City of Dallas. Total available supplies from the two reservoirs are estimated at nearly 40,000 acre-feet per year. Supplies are expected to meet projected demands through the 2050 planning year.

The City of Denton owns and operates a wastewater treatment facility recently upgraded and expanded to a permitted 15 MGD capacity. The City intends to expand the plant further to a capacity of about 20 MGD by the year 2010.

**Irving.** The City currently meets its water needs by purchasing necessary supplies from DWU, and also has contracts for about 40,000 acre-feet of water per year from Lake Cooper. The City plans to develop transmission facilities in conjunction with NTMWD to deliver future water supplies to Irving, which are expected to meet demands through the year 2050.

The City contracts with the TRA for wastewater treatment services at the Central WWTP and plans to continue using the facility in the future.

**Waxahachie.** The City's present water needs are supplied from Lake Waxahachie and by the TRA from Lake Bardwell. Projections indicate that supplies will continue to meet demands for the City through the planning year 2050, with future supplies possibly coming from the TRA's Lake Joe Pool.

**Weatherford.** The water supply for the City is currently provided by Lake Weatherford, with minor amounts of groundwater from City wells completed into the Trinity Aquifer. Future supplies for the City will continue to be met from Lake Weatherford and from contracts with Tarrant Regional Water District through the 2050 planning year.

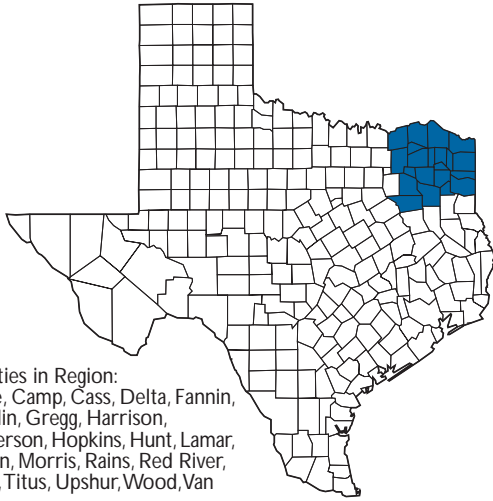
**Plano.** Water supplies for the City of Plano are obtained from the NTMWD. Projections indicate that future demands for the City will continue to be met by the NTMWD through the year 2050.

**Arlington.** The majority of the water needs for the City of Arlington are met by water provided by TRWD, with a smaller portion supplied by the City's Lake Arlington. Future demands will continue to be met by these supplies through the year 2050.

**Flower Mound.** The City obtains its water supply from DWU. Projections indicate that future demands will continue to be supplied from DWU through the year 2050.

# Northeast Texas Region

## Location Of Region



## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Tyler	79,812	111,076
• Longview	73,939	108,979
• Texarkana	33,096	32,463

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Paper & Allied Products
- Chem. & Allied Products
- Food & Kindred
- Ind. & Commercial Machinery Equip.

### Major Irrigated Crops

- Rice
- Peanuts
- Soybean
- Cotton

**Figure 3-21**

## Historical and Projected Population and Water Use

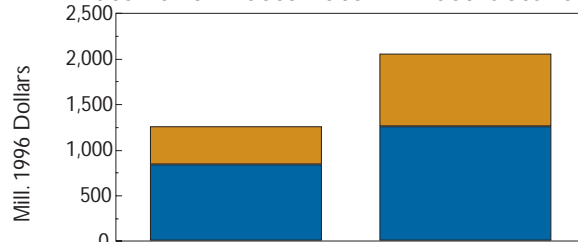
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	835,341	970,005	1,049,510	1,082,943	29.6%
% of State Total	4.92%	4.13%	3.42%	2.95%	-----
Municipal Water Use	133,858	153,220	153,177	154,173	15.2%
Industrial Water Use/1	375,790	485,316	516,866	588,893	56.7%
Agricultural Water Use/2	41,714	42,503	42,110	41,746	0.1%
Irrigation Adjustment /3	0	0	0	0	-----
Total Water Use (ac-ft)	551,362	681,039	712,153	784,812	42.3%
% of State Total	3.51%	4.30%	4.82%	5.26%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Tyler	15,994	19,285
Longview	15,859	19,165
Texarkana	5,893	4,800
Paris	7,039	6,918
Marshall	4,952	4,454
Kilgore	2,731	3,189

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.



### 3.2.4 Northeast Texas Region

**Regional Description.** The Northeast Region is comprised of 21 counties in portions of the Red, Sulphur, Sabine, Trinity, and Neches river basins, and Cypress Creek Basin. From 1980 to 1990, population in the Northeast Region increased 11.8 percent from 747,487 to 835,341. The region is projected to experience moderate population growth, reaching almost 1.1 million by 2050 or an increase of about 30 percent over the 1990 population. The region accounted for almost 5 percent of State's population in 1990, and accounted for less than 4 percent of the State's water use.

Total water use in the region in 1990 was approximately 551,400 acre-feet. By 2050, total water use is projected to increase about 42 percent to about 785,000 acre-feet. Industrial water use, which includes manufacturing, steam-electric power cooling, and mining, is the predominate water-use category in the region, and is projected to increase about 57 percent from 1990 to 2050. Municipal water use is projected to increase 15 percent. Agricultural water use is projected to remain relatively stable over the projection period.

Water conservation in the municipal sector is projected to save 27,000 acre-feet by 2020, and 38,000 acre-feet by 2050. Conservation measures in the manufacturing sector are projected to save almost 20,000 acre-feet by 2020, and 36,000 acre-feet by 2050. Projected water savings are actually a reduction in the increased water use that would occur without conservation.

**Regional Water-related Problems and Needs.** In many areas of the region, shallow groundwater has high concentrations of iron and is acidic, making the water undesirable for municipal use and most manufacturing processes. The problems can be solved, for the most part, by completing wells in deeper water-bearing zones or by treatment of the water from the shallower wells. Surface water, and good quality groundwater, are potentially available to meet projected water needs for the region, if projects are planned and developed on schedule. Dissolved oxygen content of streams is periodically low due to low streamflow and low natural reaeration rates. Also, flooding is a major problem in many areas of the region.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Sulphur River Municipal Water District (SRMWD).** The Sulphur River Municipal Water District was created in 1955 and serves Delta, Hopkins and Hunt counties. The SRMWD owns 26.282 percent of the water stored in Lake Cooper and will use that water to fulfill the needs of its customer cities (Cooper, Commerce and Sulphur Springs). During the next 50 years, the member cities could have excess supplies in Lake Cooper. In fact, the Upper Trinity Regional Water District has entered into an agreement with the City of Commerce for the temporary, interim purchase of water from Commerce's share of Lake Cooper water. Any excess water the district's member cities have could be used in the Dallas/Fort Worth Metroplex.

**Northeast Texas Municipal Water District (NETMWD).** Northeast Texas MWD was created in 1953 and serves Marion, Upshur, Morris, Cass, and Camp counties. The District owns storage rights in the Lake O' the Pines Reservoir and supplies water to its customer cities, as well as industrial and steam-electric power plants in the Cypress and Sabine river basins. The District currently supplies water to the Brandy Branch cooling lake which is located in the Sabine River Basin and has contracted to supply up to 20,000 acre feet to the City of Longview in the Sabine Basin. The District has excess supplies that can be used to meet demands in the Cypress or Sabine river basins.

**Sabine River Authority (SRA).** The Sabine River Authority was created by the Texas Legislature in 1949 as a conservation and reclamation district to control, store, preserve, and distribute the waters of the Sabine River and its tributaries for beneficial purposes. The service area of the SRA includes all or parts of nine counties (Rains, Woods, Gregg, Panola, Shelby, Sabine, Newton, Orange and Jasper). The SRA owns and operates three reservoirs, two (Lake Fork and Lake Tawakoni) within the Northeast Texas Region, while the third (Toledo Bend Reservoir) lies within the East Texas Region. The SRA has contracted to provide water supplies to numerous municipalities, water supply corporations, and industrial users in the region. In addition, the SRA has contracted to provide Dallas Water Utilities (in the Trinity River Basin) over 300,000 acre-feet per year from Lake Fork and Lake Tawakoni.

**Tyler.** Water needs for the City are met by surface water from Lake Tyler and groundwater from wells completed in the Carrizo-Wilcox Aquifer. It is anticipated that ground water withdrawals will remain at approximately present levels, while future needs will be met by increased use of Lake Tyler. The City also holds contracts for water from Lake Palestine if needed. It is anticipated that the City will be able to meet its future water needs through the year 2050 by using its present supplies.

The City of Tyler owns two wastewater treatment facilities; the Westside WWTP has a 13 MGD capacity and the Southside WWTP has a 9 MGD capacity. Both plants have recently undergone upgrades to comply with more stringent permit requirements.

**Longview.** The City of Longview holds contracts for water in Lake Cherokee and Lake Fork, as well as having water rights to flows in the Sabine River and Big Sandy Creek. In general, the majority of their water needs in the past have been met by Lake Cherokee and the Sabine River. The City also holds contracts with NETMWD for water from Lake o' the Pines in the Cypress Creek Basin (and has authorization for the associated interbasin transfer). Longview has not yet needed to use water from this source, but plans to in the future. The City should be able to meet its future water needs through the year 2050 from its present water supplies.

The City of Longview operates a wastewater treatment plant and collection system which is presently being rehabilitated with funding from the Board's State Water Pollution Control Revolving Fund (SRF). The facility is currently permitted for 16.5 MGD but has plans for expansion in the near future to meet the City's needs through the year 2014.

**Texarkana.** The water needs for the City of Texarkana are supplied by Lake Wright Patman (formerly Lake Texarkana). The City also serves as a water supplier for several communities and water supply companies located in Bowie and Red River counties, and in Miller County, Arkansas. Interbasin transfers have been authorized, where required, for these supplies. It is anticipated that the City will be able to meet its water needs, as well as those of its customers, through the 2050 planning year.

Texarkana operates three wastewater treatment facilities; the New Regional South WWTP recently expanded to 16.5 MGD from 11.7 MGD, the 2 MGD Wagner Creek WWTP, and the 0.05 MGD Rollingwood WWTP which serves a small, isolated subdivision. All three facilities have recently undergone modifications and improvements to meet stricter permit requirements.

**Paris.** Water needs for the City of Paris are met from Lake Crook and from Lake Pat Mayes (and involves an authorized interbasin transfer from the Red River Basin). Future water needs, through the year 2050, are expected to be met by using these existing supplies.

The City operates a 7.25 MGD wastewater treatment facility. The collection system is presently undergoing rehabilitation to correct infiltration/inflow problems.

**Marshall.** The City of Marshall has water rights to flows in Big Cypress Creek. The diversion point for the City is in the backwater of Caddo Lake, and diversions from the lake occur when flow in the creek is low. Projections indicate the City will meet its water needs through the planning year 2050 from existing supplies.

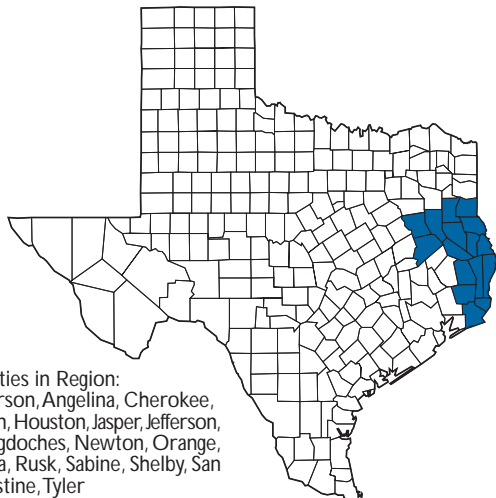
The City of Marshall owns and operates a 5.91 MGD wastewater treatment plant. The City has plans to expand the plant to a capacity of 9 MGD and will also upgrade to meet stricter permit requirements. An application for SRF funding is underway.

**Kilgore.** The City of Kilgore meets its water needs from ground-water wells completed in the Carrizo-Wilcox Aquifer and from water obtained from the City of Longview. The City also purchases water from the Sabine River Authority. It is anticipated that the City will continue to meet its needs through the 2050 planning year from these existing supplies.

The City operates a 3 MGD wastewater treatment facility recently upgraded to comply with stricter permit requirements.

# East Texas Region

## Location Of Region



Counties in Region:  
Anderson, Angelina, Cherokee,  
Hardin, Houston, Jasper, Jefferson,  
Nacogdoches, Newton, Orange,  
Panola, Rusk, Sabine, Shelby, San  
Augustine, Tyler

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Beaumont	115,797	159,648
• Port Arthur	58,559	72,126
• Lufkin	32,522	51,131
• Nacogdoches	32,229	70,004

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Petroleum Refining
- Chem & Allied Products
- Lumber & Woods
- Food & Kindred

### Major Irrigated Crops

- Rice
- Soybean
- Hay/Alfalfa
- Vegetables

Figure 3-22

## Historical and Projected Population and Water Use

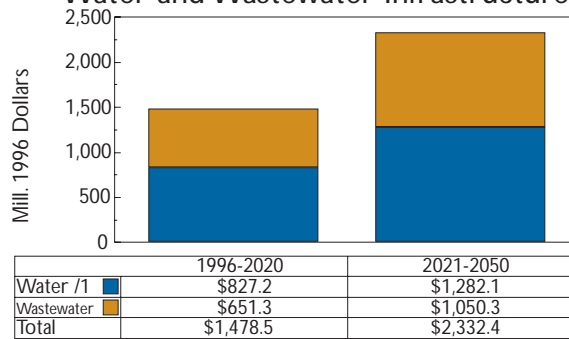
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	763,017	887,881	988,234	1,077,522	41.2%
% of State Total	4.49%	3.78%	3.22%	2.94%	-----
Municipal Water Use	113,068	131,907	135,661	143,222	26.7%
Industrial Water Use/1	333,601	395,700	477,473	564,005	69.1%
Agricultural Water Use/2	235,464	153,996	139,300	133,112	-43.5%
Irrigation Adjustment /3	0	0	0	0	-----
Total Water Use (ac-ft)	682,133	681,603	752,434	840,339	23.2%
% of State Total	4.34%	4.30%	5.09%	5.63%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Beaumont	21,800	23,606
Port Arthur	11,017	10,826
Orange	4,438	5,431
Lufkin	5,548	6,701
Nacogdoches	8,512	14,193
Jacksonville	3,311	3,426

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.5 East Texas Region

**Regional Description.** The East Region consists of 16 counties located in the Neches, Trinity, Cypress and Sabine river basins, and the Neches-Trinity Coastal Basin. From 1980 to 1990, the population of the region grew slightly from 748,197 to 763,017, an increase of almost 2 percent. More rapid population growth is projected for the future as the region is projected to reach approximately 1.1 million by 2050 or an increase of 41 percent over the 1990 population.

The East Region contains approximately 4.5 percent of State's population, and uses an almost equivalent proportion of water. Overall, total water use is projected to increase about 23 percent. The largest increase in water use is projected to be in the industrial sector which is expected to increase about 69 percent from 1990 to 2050. Industrial water use also accounts for the largest share (49 percent) of the region's water use. As the population increases, municipal water use is projected to increase almost 27 percent. Water for agriculture is projected to decline almost 44 percent. Much of the decline in agricultural water use is attributed to the anticipated decline in irrigated acreage.

Under the selected planning scenario, conservation efforts in the municipal sector are projected to save 23,600 acre-feet by 2020, and 36,000 acre-feet by 2050. Conservation in the manufacturing sector is projected to save approximately 34,000 acre-feet by 2020, and 62,000 acre-feet by 2050. Conservation in agricultural water use is projected to be minimal.

**Regional Water-related Problems and Needs.** In many areas within the northern portion of the region, shallow groundwater has high concentrations of iron and is acidic, making the water undesirable for municipal and manufacturing uses. Problems with ground-water quality can often be corrected by completing ground-water wells into deeper water-bearing strata, or from a more expensive water treatment process. In the southern portion of the region, land-surface subsidence and saltwater encroachment have resulted from overdevelopment of ground-water supplies. Saltwater intrusion during periods of low flow in the Neches River has the potential for contaminating the freshwater supplies at existing intake facilities. Smaller cities in the region are anticipated to have water treatment, conveyance, and storage problems.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Sabine River Authority (SRA).** The Sabine River Authority was created by the Texas Legislature as a conservation and reclamation district to control, store, preserve, and distribute the waters of the Sabine River and its tributaries for beneficial purposes. The service area of the SRA includes all or parts of nine counties (Rains, Woods, Gregg, Panola, Shelby, Sabine, Newton, Orange and Jasper) . The SRA owns and operates three reservoirs, two (Lake Fork and Lake Tawakoni) within the Northeast Texas Region, while the third (Toledo Bend Reservoir) lies within the East Texas Region. The SRA has contracted to provide water supplies to numerous municipalities, water supply corporations, and industrial users in the region. In addition, the SRA has

entered into an agreement with the adjacent San Jacinto River Authority to supply up to 672,000 acre-feet per year from Toledo Bend Reservoir. The two river authorities will use existing canal systems where possible to deliver water to the San Jacinto Basin, thereby reducing environmental impacts associated with the routing.

**Upper Neches River Municipal Water Authority (UNRMWA).** The Upper Neches River Municipal Water Authority serves Anderson, Henderson, Smith and Cherokee counties. The Authority is primarily responsible for supplying water from Lake Palestine to its customer cities and contract buyers. The UNRMWA is permitted to supply 238,000 acre-feet of water per year to its service area customers and is also heavily involved in monitoring water quality in its service area. Although the Authority is not involved in water/wastewater treatment, it monitors return flows from treatment plants to verify compliance with water quality standards.

**Lower Neches Valley Authority (LNVA).** The Lower Neches Valley Authority serves Jefferson, Chambers, Hardin, Liberty and Tyler counties. The Authority provides water from Sam Rayburn Reservoir and the Neches River to its customer cities, and industrial complexes in the cities of Beaumont and Port Arthur, and irrigation farmers in Jefferson County. The authority has the capacity to distribute over one billion gallons of water per day through over 400 miles of canal systems. Construction of a permanent salt water barrier on the lower Neches River is recommended to protect the water supplies from sea water intrusion.

The LNVA operates a 22 MGD industrial wastewater treatment facility for the Beaumont area. The proposed salt water barrier on the lower Neches River is sponsored by the authority.

**Angelina and Neches River Authority (ANRA).** The Angelina and Neches River Authority was created in 1935 as the Sabine-Neches Conservation District. The District was changed to the Neches River Conservation District in 1949 when the Sabine River Authority was created. The Neches RCD was changed to the present ANRA in 1977. The Authority serves all of the counties in the Lower Neches River sub-basin and some counties in the Upper Neches River sub-basin. The Authority has a state permit for the unbuilt Lake Eastex project which could possibly provide water supplies for Smith, Rusk, Cherokee, Nacogdoches, and Angelina counties if needed. Evaluations of the water resources in the region by TWDB staff indicate that there should be adequate supplies in the region without the development of Lake Eastex.

**Beaumont.** Water supplies for the City are provided by groundwater from the Gulf Coast Aquifer and surface water from the Neches River (Lake Sam Rayburn). With construction of the salt-water barrier on the lower Neches River, existing supplies will meet projected demands for the City through the year 2050.

Beaumont is served by a 30 MGD wastewater treatment plant located on Hillebrandt Bayou. Advanced treatment requirements are met with an artificial wetlands system.

**Port Arthur.** Water supplies for Port Arthur are met totally by surface water supplied by Lake Sam Rayburn through LNVA. With the construction of the saltwater barrier on the Neches

River, projections indicate that supplies would meet demands for the City through the 2050 planning year.

Four wastewater treatment facilities serve the Port Arthur area. Two serve the main part of the City, one serves Pleasure Island, and one serves the Sabine Pass area. The two primary plants, the 9.2 MGD Main Plant and the 2.6 MGD Port Acres Plant, have recently undergone upgrades. Maintenance of collection lines in the dynamic soil conditions existing in the area is a continuing problem.

**Orange.** The water supply for the City is obtained from ground-water wells completed into the Gulf Coast Aquifer. Projections indicate that demands by the City will continue to be met by available ground-water supplies through the 2050 planning period.

Improvements to the City's water treatment plant are needed for compliance with the new safe drinking water regulations. An application for the Board's drinking water SRF funding is anticipated.

**Lufkin.** Water supplies for the City of Lufkin are met by groundwater from the Carrizo-Wilcox Aquifer. The City also holds contracts for surface water supplied from Lake Sam Rayburn. Supplies will continue to meet demands by the City through the year 2050.

**Nacogdoches.** Water demands by the City are presently met by groundwater withdrawn from the Carrizo-Wilcox Aquifer and from surface water supplied by Lake Nacogdoches. Projections indicate that these water supply sources will continue to meet future demands by the City through the year 2050.

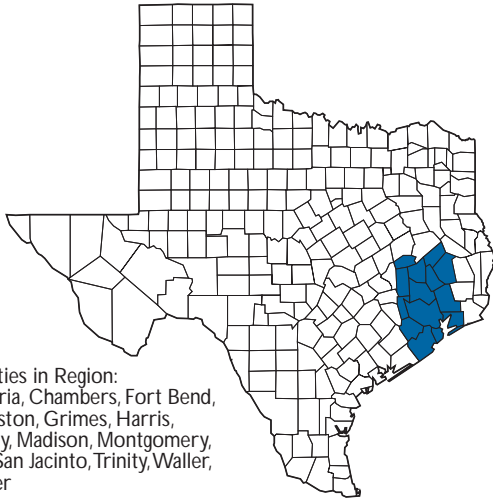
A new wastewater treatment facility is planned for the City. System improvements to existing water treatment facilities are also required to comply with the new safe drinking water regulations, and an application for SRF funding is being pursued.

**Jacksonville.** The City is presently supplied by groundwater from the Carrizo-Wilcox Aquifer and by surface water from Lake Jacksonville. Projections through the year 2050 indicate that demands by the City will continue to be met by these supplies.

System improvements to the City's water treatment facility are needed in order to comply with the new safe drinking water regulations. An application for SRF funding is being pursued.

# Houston Region

## Location Of Region



Counties in Region:  
Brazoria, Chambers, Fort Bend,  
Galveston, Grimes, Harris,  
Liberty, Madison, Montgomery,  
Polk, San Jacinto, Trinity, Waller,  
Walker

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Houston	1,741,257	3,220,889
• Pasadena	129,483	229,703
• Baytown	68,505	145,612
• Galveston	62,947	121,257

/1 State Data Center    /2 TWDB

### Major Water-Using Industries

- Chem/Allied Products
- Petroleum Refining
- Paper/Allied Products
- Food & Kindred

### Major Irrigated Crops

- Rice
- Soybean
- Vegetables
- Cotton

Figure 3-23

## Historical and Projected Population and Water Use

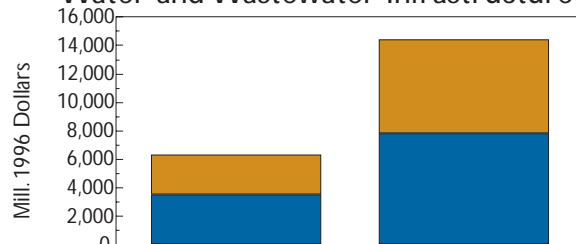
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	3,870,311	5,325,508	7,053,433	8,617,796	122.7%
% of State Total	22.78%	22.67%	23.00%	23.50%	-----
Municipal Water Use	655,249	944,181	1,153,938	1,333,056	103.4%
Industrial Water Use/1	742,697	926,385	1,032,147	1,229,369	65.5%
Agricultural Water Use/2	499,732	429,558	381,689	353,525	-29.3%
Irrigation Adjustment /3	0	(12,460)	(1,138)	(9,349)	-31.9%
Total Water Use	1,897,678	2,287,664	2,566,636	2,906,601	53.2%
% of State Total	12.06%	14.45%	17.38%	19.49%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Houston	372,675	548,394
Galveston	12,906	19,966
Sugar Land	7,940	22,471
Rosenberg	3,177	6,708
Missouri City	8,411	21,000
Baytown	13,239	19,245
Deer Park	5,588	7,703

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$3,518.9	\$7,817.2
Wastewater	\$2,794.0	\$6,563.8
Total	\$6,312.9	\$14,381.0

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.



### 3.2.6 Houston Region

**Regional Description.** The Houston Region is composed of 14 counties in portions of the Brazos, Trinity, San Jacinto, and Neches river basins, and the Brazos-Colorado, San Jacinto-Brazos, Neches-Trinity, Trinity-San Jacinto coastal basins. The population of the Houston Region was 3.231 million in 1980, increasing to 3.870 million by 1990. The region was the second most populated region in the State in 1990 following the North Central Region. By 2050, the region's population is anticipated to increase by almost 123 percent to about 8.6 million.

While the Houston Region represented 23 percent of the State's total population in 1990, it accounted for approximately 12 percent of the State's water use. Much of the water is used for municipal and industrial purposes which account for 35 percent and 39 percent of the region's water use, respectively. Related to population growth, municipal water use is projected to be the fastest growing component of regional water use, increasing by a projected 103 percent by 2050. Industrial water use is projected to increase about 66 percent, while agricultural water use is projected to decline almost 32 percent. Overall, the region's total water use is projected to increase approximately 53 percent from 1990 to 2050.

Under the selected planning scenario, municipal conservation efforts in the region are projected to save 171,000 acre-feet in 2020 and 330,000 acre-feet by 2050. Manufacturing water use is projected to save 111,000 acre-feet by 2020 and 203,000 acre-feet by 2050 over scenarios that do not include conservation measures.

**Regional Water-related Problems and Needs.** Ground-water use currently comprises 33 percent of all water used in the region; however, by year 2050 ground-water use will comprise only 17 percent. This is due in large part to the regulations imposed by the Harris-Galveston Coastal Subsidence District regarding limitation of ground-water withdrawal and conversion from groundwater to surface water. The conversion to surface water will require a commitment of considerable energy, cooperative effort and funding. Conveyances (e.g., Luce Bayou and the new Coastal Water Authority pipeline under the Houston Ship Channel) and additional water treatment facilities will also be needed.

Management of the Galveston Bay system (Trinity-San Jacinto Estuary) will likely be guided by results of a study on freshwater inflows jointly performed by the Texas Parks and Wildlife Department and the Texas Water Development Board. Preliminary analyses for that study have been performed, but final recommendations are pending. Re-use of water should supply some water for steam-electric power cooling, irrigation and a few nonconsumptive industrial uses.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Harris-Galveston Coastal Subsidence District (HGCS D).** HGCS D was created in 1975 in response to concern over subsidence which contributes to hurricane storm surge flooding in

coastal areas and to fresh-water flooding of other areas. HGCSO regulates the withdrawal of groundwater within Harris and Galveston counties. HGCSO currently operates under its 1992 District Plan which divides the District into seven regulatory areas. Each area must convert a certain portion of its ground-water use to surface water use, so that by year 2020 no more than 20% of the total water use is from groundwater.

**Houston-Galveston Area Council (HGAC).** HGAC is a regional council of governments composed of member cities, counties, and special districts. Its regional boundary includes Walker, Montgomery, Harris, Liberty, Chambers, Galveston, Brazoria, Fort Bend, Waller, Austin, Colorado, Wharton and Matagorda counties. Its assistance to member governments includes providing a forum for some regional water issue discussions and programs such as the Galveston Bay National Estuary Program. HGAC also provides water quality planning in the Houston designated area and through the Clean Rivers Program.

**Trinity River Authority (TRA).** The Trinity River Authority, operating under a master plan originally adopted in 1958 and revised periodically, implements water supply and wastewater projects serving cities and special districts throughout the Trinity Basin. The portion of TRA's service area lying within the Houston Area region includes portions of Madison, Walker, Trinity, Polk, San Jacinto and Liberty counties. TRA provides water to Huntsville and developments around Lake Livingston. TRA, as a co-owner with the City of Houston of the water right for Lake Livingston, potentially could be a major supplier of water to the City of Houston's service area.

**San Jacinto River Authority (SJRA).** SJRA provides municipal and manufacturing water supplies to east Harris County from Lake Conroe and the San Jacinto River at Lake Houston. Water is also diverted from Lake Conroe to Lewis Creek Reservoir for steam-electric power generation. SJRA owns and operates a pump station at Lake Houston from which it diverts raw water into an extensive system of canals for ultimate delivery to industries in east Harris County. SJRA owns and operates regional water and wastewater facilities which serve ten municipal utility districts in The Woodlands. The Authority also has obtained 50,000 acre-feet of water supplies from the Trinity Basin via Devers Canal. The Authority intends to use the Trinity River water to meet the needs in east Harris County, freeing water in Lake Conroe for use in Montgomery County. SJRA operates an automated network of rainfall and stream flow monitoring stations in support of its lake operations.

**Gulf Coast Waste Disposal Authority (GCWDA).** GCWDA provides waste disposal systems for forty square miles in Chambers, Harris and Galveston counties, including four industrial wastewater treatment facilities located along the Houston Ship Channel, in Bayport and Texas City, and 23 municipal wastewater treatment facilities. GCWDA also provides water service through its seven water treatment plants. In addition, GCWDA handles an increasing volume of solid wastes from industrial and municipal sources and is developing regional approaches to resource recovery from municipal solid wastes and to municipal sludge disposal.

**Coastal Water Authority (CWA).** Created in 1963, CWA provides water to Harris County including the industrial complexes along the Houston Ship Channel. Water is imported from the

Trinity Basin through a canal system and siphon under the ship channel to the industrial complex and to the new southeast regional water treatment plant.

**Fort Bend Subsidence District.** The District includes all of Fort Bend County and has yet to develop a groundwater-to-surface water conversion plan. The District coordinates with the Harris-Galveston Coastal Subsidence District and has hired them to manage the operations of the Fort Bend district. It is anticipated that the conversion plans for the Fort Bend district will be similar to those of the HGCSO.

**Brazos River Authority (BRA).** BRA provides water to entities in the region from reservoirs in the Brazos River Basin. A more thorough discussion of the BRA is provided in the "Brazos River Basin" section. The other major suppliers of water for use in the Houston Region are Dow Chemical Company, Chocolate Bayou Company, and Galveston County Water Authority which use Brazos River diversions backed-up by water supplies from Brazos River Authority reservoirs. The Brazos River Authority recently received SRF funding from TWDB to make improvements to its Sugar Land Regional Sewage System. This system serves the City of Sugar Land, Nalco Chemical Company, Imperial Sugar Company, several member municipal utility districts, and additional non-member districts via their contract with Fort Bend County MUD #13.

**Houston.** The City of Houston owns all water diversion rights from Lake Houston and seventy percent of the water diversion rights from Lake Livingston. Additional surface water diversion facilities from the Trinity River Basin and the use of water supplies from the Sabine River Basin will be needed to meet the City's future demands, and to convert from groundwater to surface water use as required by the Harris-Galveston Coastal Subsidence District. The City of Houston also provides treated water to a number of other cities that are converting from groundwater to surface water and will continue to be a major water provider in the region. However, the Houston area will increasingly be served by water imported from the Sabine River Basin to the east. This arrangement, in turn, will create a "piggyback effect" whereby water from the more nearby sources (Lake Houston and Lake Livingston) may be used to serve customer cities in the more southerly or westerly portions of the Houston service area.

The City of Houston has embarked on an aggressive program of upgrading its existing wastewater treatment system, including extensive rehabilitation of its Sims Bayou facilities, the Northeast Service Area and Hermann Park, and has been an active participant in the Board's SRF Program.

**Sugar Land and Rosenberg.** Both of these cities currently obtain groundwater from the Gulf Coast Aquifer. Due to increases in their demands, the cities will need additional water by the year 2030. The recommended Allens Creek Reservoir should serve the needs of both cities. A detailed discussion of Allens Creek Reservoir appears in the "Brazos River Basin" section.

**Missouri City.** This City should be able to satisfy its demands throughout the 50-year planning period by continuing to rely on ground-water withdrawals from the Gulf Coast Aquifer.

**Baytown.** The City of Baytown currently obtains groundwater from the Gulf Coast Aquifer and surface water from Lake Livingston via the CWA pipeline. These sources will continue to satisfy demands throughout the 50-year planning period. The City recently received SRF funds from TWDB to rehabilitate a sewer main and some older sewer lines.

**Deer Park.** The City of Deer Park obtains Lake Livingston water purchased raw from the City of Houston via the CWA Southwest Line. By the year 2020, the City will benefit from the Luce Bayou conveyance and the CWA-2 pipeline. The City also withdraws groundwater from the Gulf Coast Aquifer. These sources will satisfy demands through the 50-year planning period. The City has recently received SRF funds from TWDB to rehabilitate older sewer lines.

**Galveston.** The City of Galveston will continue to need the water provided by the City of Houston and water from the Galveston County Water Authority. The City will also continue to rely on ground-water withdrawals from the Gulf Coast Aquifer, but only to the degree allowed by Harris-Galveston Coastal Subsidence District regulations. Galveston County MUD #12 recently received SRF and Development Fund loans from TWDB to construct a new 0.4 MGD wastewater treatment plant and to add improvements to the water treatment facilities, respectively.

**Pasadena.** The City of Pasadena will continue to obtain water through CWA's Southwest Line; however, additional facilities will need to be developed to move more water to the southwest treatment plant. The City will also continue to rely on pumpage of groundwater from the Gulf Coast Aquifer, but only to the degree allowed by Harris-Galveston Coastal Subsidence District regulations.

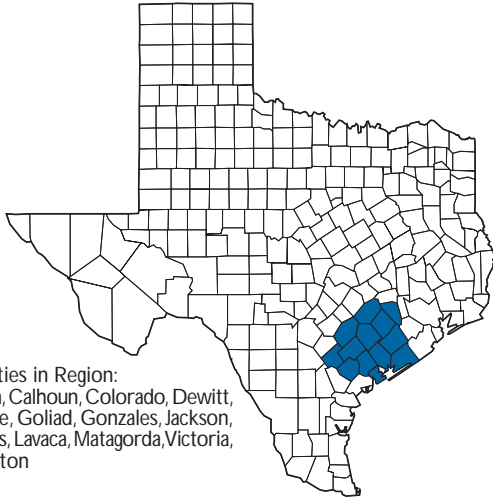
**The Woodlands.** The Woodlands, an unincorporated urban planned community served by the San Jacinto River Authority, will benefit from improvements to SJRA's regional water supply system recently funded by Water Development Fund loans from TWDB and from construction of a new SJRA 2.6 MGD wastewater treatment plant.

**Lake Jackson.** The City of Lake Jackson and other cities and communities in Brazoria County will rely more on Brazos River diversions, whether supplied directly by the Brazos River Authority or by another entity. Also, both Brazoria County and Fort Bend County will need to obtain water from the recommended Allens Creek Reservoir by about the year 2030. A detailed discussion on Allens Creek Reservoir is presented in the "Brazos River Basin" section.

**Conroe.** The City of Conroe currently relies solely on groundwater withdrawn from the Gulf Coast Aquifer. The City could experience a water shortage and should plan to use water from the San Jacinto River Authority's Lake Conroe by the year 2010. The City should also institute some re-use by the year 2040 and contract with SJRA for a portion of its Lake Houston water by year 2050.

# Mid-Coast Region

## Location Of Region



Counties in Region:  
Austin, Calhoun, Colorado, Dewitt,  
Fayette, Goliad, Gonzales, Jackson,  
Karnes, Lavaca, Matagorda, Victoria,  
Wharton

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Victoria	60,942	91,560
• Bay City	18,462	33,871
• Port Lavaca	11,553	17,122

/1 State Data Center    /2 TWDB

### Major Water-Using Industries

- Chem. & Allied Products
- Stone & Clay Products
- Food & Kindred
- Petroleum Refining

### Major Irrigated Crops

- Rice
- Corn
- Sorghum
- Cotton

Figure 3-24

## Historical and Projected Population and Water Use

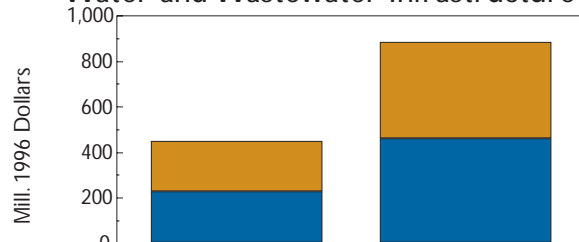
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	314,816	374,872	436,503	506,836	61.0%
% of State Total	1.85%	1.60%	1.42%	1.38%	-----
Municipal Water Use	51,761	59,949	64,269	72,070	39.2%
Industrial Water Use/1	153,041	216,065	266,710	306,600	100.3%
Agricultural Water Use/2	921,480	737,073	673,677	620,480	-32.7%
Irrigation Adjustment /3	0	(7,405)	(12,395)	(12,899)	-35.1%
Total Water Use (ac-ft)	1,126,282	1,005,682	992,261	986,251	-12.4%
% of State Total	7.16%	6.35%	6.72%	6.61%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Victoria	10,850	14,051
Bay City	3,340	4,780
Port Lavaca	1,836	2,186
Gonzales	1,703	1,743
Goliad	443	472
Columbus	1,018	1,321

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$227.2	\$459.1
Wastewater	\$220.6	\$424.0
Total	\$447.8	\$883.1

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.7 Mid-Coast Region

**Regional Description.** The Mid-Coast Region is comprised of 13 counties located in the Brazos, Colorado, Guadalupe, Lavaca, Nueces and the San Antonio river basins, and the Brazos-Colorado, Colorado-Lavaca, San Antonio-Nueces, and the Lavaca-Guadalupe coastal basins. The population of the Mid-Coast Region increased slightly from 308,760 in 1980 to 314,816 in 1990, an increase of almost 2 percent. The Mid-Coast Region is projected to experience more rapid growth in the future as population is projected to reach about 507,000 by 2050, an increase of 61 percent over the planning period.

Total water use in the Mid-Coast Region was about 1.1 million acre-feet in 1990. By 2050, the region is expected to use slightly less than 1.0 million acre-feet, a decrease of about 12 percent. Agriculture represents the largest component of water demand, accounting for about 82 percent of the region's total water use in 1990. By 2050, water for agriculture is projected to decline about 35 percent. Industrial water use is projected to be the fastest growing category in the region, doubling by 2050. Municipal water use is projected to increase about 39 percent by 2050.

Under the selected planning scenario, conservation in the municipal sector is projected to save 10,000 acre-feet by 2020, and 17,000 acre-feet by 2050. Conservation in manufacturing is projected to save 24,000 acre-feet of water by 2020, and 35,000 acre-feet by 2050 compared to scenarios that include no conservation.

**Regional Water-related Problems and Needs.** Agricultural water supplies are expected to experience significant shortages in the region by the year 2000 and continue through 2050 if alternative water supplies are not developed. Furthermore, salt-water intrusion is a concern which may affect ground water quality (potability) as pumping from the Gulf Coast Aquifer increases.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Guadalupe-Blanco River Authority (GBRA).** The Authority is a regional entity serving Hays, Comal, Guadalupe, Caldwell, Gonzales, De Witt, Victoria, Kendall, Refugio, and Calhoun counties. GBRA's activities include supplying hydroelectric power through operation of six hydroelectric dams located on the Guadalupe River in Guadalupe and Gonzales counties; supplying potable water and treatment of wastewater to rural areas; supplying raw water and managing storage rights in Canyon Reservoir as authorized by the TNRCC and in compliance with the U.S. Army COE operating agreement for the reservoir. Using present estimates of available supplies, GBRA should have adequate resources to meet the region's needs through 2050.

**Lavaca-Navidad River Authority (LNRA).** LNRA owns 43 percent of the permitted water in Lake Texana. It currently has contracts to sell water to the Port of Corpus Christi Authority, Formosa Plastics, the City of Point Comfort and Inteplast Corp. However, the conveyance facil-

ities to the Port of Corpus Christi are not expected to be completed until 2005. Excess supplies that remain in the project could be used to meet further demands in the Corpus Christi area or demands in the San Antonio area. Using present estimates of available supplies, the Authority should have adequate resources to meet the region's needs through 2050.

**Lower Colorado River Authority (LCRA).** LCRA is a conservation and reclamation district created by the Texas Legislature in 1934. Its ten-county statutory boundaries encompass a region from San Saba County downstream to Matagorda County. The LCRA regulates discharge from its six reservoirs, contributing to flood control, and sells water for municipal, irrigation and industrial use in the Lower Colorado Basin. Water for irrigation is the primary use in the Mid Coast Region.

**Gonzales Co. WSC (GCWSC).** The water supply corporation is a local entity serving Gonzales, Caldwell, and De Witt counties. It diverts surface water from Lake H-5 on the Guadalupe River and distributes the water to its customer counties. Currently, the GCWSC owns two ground-water wells and also purchases ground water from wells in Smiley. Using present estimates of available supplies, the Authority should have adequate resources to meet the region's needs through 2050.

**Victoria.** The primary water supply for the City of Victoria is the Gulf Coast Aquifer. The City has recently obtained run-of-the-river water rights to 20,000 acre-feet of water from the Guadalupe River to blend with groundwater to meet its demands. System improvements to Victoria's water treatment facilities are also needed to comply with the Safe Drinking Water Act. It is anticipated that the City of Victoria will apply for and receive funding for the necessary improvements. Present estimates indicate that the City's ground-water supplies, blended with surface water from the Guadalupe River and in conjunction with an effective water conservation program, will meet Victoria's future water needs through 2050.

**Bay City.** Bay City receives all of its water from the Gulf Coast Aquifer. If increased ground-water usage caused by the expansion of industry and population into the region as a whole results in deteriorated ground-water quality from saltwater intrusion, alternative surface water supplies, such as water from the Colorado River through a run-of the-river permit, will be necessary. Otherwise, the use of present supply sources available to the City, in conjunction with an effective water conservation program, will allow Bay City to meet future water needs through 2050.

**Port Lavaca.** The City of Port Lavaca has contracts to purchase 100% of its surface water from the GBRA via releases from Canyon Dam and Guadalupe River run-of-the-river permit withdrawals. Using the present supply sources available to the City, in conjunction with an effective water conservation program, Port Lavaca is expected to meet its future water needs through 2050.

**Gonzales.** The source of water for the City of Gonzales is the Carrizo-Wilcox Aquifer and the Guadalupe River. Using the present supply sources, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through 2050.

**Goliad.** The source of water for the City of Goliad is the Gulf Coast Aquifer. Using the present supply sources, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through 2050.

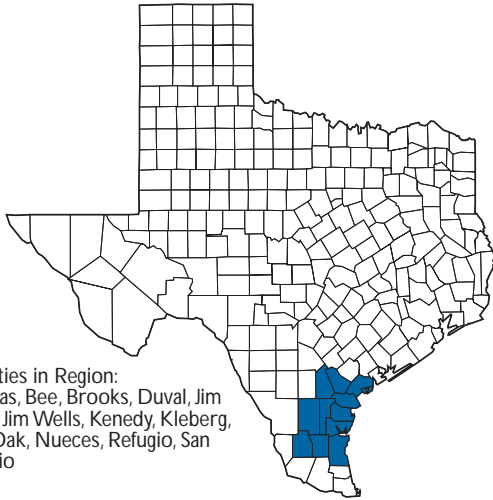
**Columbus.** The source of water for the City of Columbus is the Gulf Coast Aquifer. Using the present supply sources, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through 2050.

**Sealy.** The source of water for the City of Sealy is the Gulf Coast Aquifer. The City's future water demands can continue to be met with groundwater through the 50-year planning period. However, if this becomes infeasible or insufficient, the City may augment its supply with surface water, possibly from the recommended Allens Creek Reservoir project which would be located nearby.



# Coastal Bend Region

## Location Of Region



Counties in Region:  
Aransas, Bee, Brooks, Duval, Jim Hogg, Jim Wells, Kenedy, Kleberg, Live Oak, Nueces, Refugio, San Patricio

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Corpus Christi	273,620	523,099
• Kingsville	26,383	50,027
• Alice	20,138	24,860
• Beeville	14,077	25,138

/1 State Data Center    /2 TWDB

### Major Water-Using Industries

- Petroleum Refining
- Chem. & Allied Products
- Food & Kindred
- Stone, Clay & Glass

### Major Irrigated Crops

- Hay/Alfalfa
- Corn
- Sorghum
- Cotton

Figure 3-25

## Historical and Projected Population and Water Use

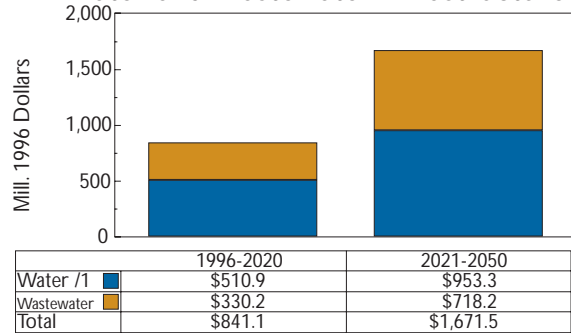
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	505,097	652,033	797,741	938,342	85.8%
% of State Total	2.97%	2.78%	2.60%	2.56%	-----
Municipal Water Use	110,323	124,299	141,908	163,463	48.2%
Industrial Water Use/1	53,457	83,704	97,830	121,599	127.5%
Agricultural Water Use/2	24,622	21,252	19,389	17,851	-27.5%
Irrigation Adjustment /3	0	0	0	0	-----
Total Water Use	188,402	229,255	259,127	302,913	60.8%
% of State Total	1.20%	1.44%	1.75%	2.03%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Kingsville	5,513	7,397
Beeville	2,408	3,097
Alice	3,420	3,119
Refugio	660	635
Ingleside	693	992

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.8 Coastal Bend Region

**Regional Description.** The Coastal Bend Region contains 12 counties located in the Nueces and San Antonio river basins, and the San Antonio-Nueces and Nueces-Rio Grande coastal basins. Population in the region was 481,925 in 1980, growing to 505,097 by 1990. The region is projected to experience relatively rapid growth throughout the planning period, reaching about 938,000 people by 2050, an increase of nearly 86 percent. The region contains almost 3 percent of the State's population, and uses approximately 1 percent of the State's water resources.

In 1990, total water use in the region was about 188,400 acre-feet. By 2050, water use is projected to increase nearly 61 percent, to about 303,000 acre-feet. Industrial water use, which accounts for 28 percent of the region's total water use, is projected to more than double over the projection period. Municipal water use is projected to increase about 48 percent, and water for agriculture is projected to decline about 28 percent over the planning period.

Under the selected planning scenario, combined conservation measures from municipal, manufacturing and irrigation uses are projected to save nearly 33,000 acre-feet by 2020 compared to scenarios with no conservation. By 2050, these savings are projected to increase to 53,000 acre-feet. Most of the conservation savings are projected to come from municipal conservation programs and practices.

**Regional Water-related Problems and Needs.** The region has insufficient surface water supplies to meet the needs of the regional economy. The region is in serious need of further surface water development/conveyances in order to provide sufficient water supplies during prolonged periods of below-normal rainfall. Completion of the pipeline from Lake Texana to Corpus Christi, begun in 1997, will alleviate some of the water supply shortages.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**South Texas Water Authority (STWA).** The water authority supplies water to Kingsville, Agua Dulce, Riviera Beach, and several other small towns. The Authority purchases water from the City of Corpus Christi. System improvements to the STWA's water treatment facilities are needed to comply with the Safe Drinking Water Act. It is anticipated that the STWA will apply for and receive funding for the necessary improvements. With the ability to purchase additional water supplies from Corpus Christi, the Authority should be able to obtain enough water to fulfill its customers' needs through 2050.

**Nueces River Authority (NRA).** The Authority owns part of the Choke Canyon Reservoir, which supplies water to the City of Corpus Christi. The NRA is also the lead agency for the Clean Rivers Program in the Nueces River Basin.

**San Patricio Municipal Water District No.1 (SPMWD1).** The District purchases surface water from the Nueces River via the City of Corpus Christi. System improvements to the District's water treatment facilities are needed to comply with the Safe Drinking Water Act. It is anticipated that the District will apply for and receive funding for the necessary improvements. The District supplies water to the cities of Odem, Taft, Portland, Gregory, Ingleside, Aransas Pass, Port Aransas, and Rockport.

**Corpus Christi.** The City of Corpus Christi owns Lake Corpus Christi and part of Choke Canyon Reservoir. The two sources are operated as a water supply system, called the Choke Canyon-Lake Corpus Christi System. The system presently can supply approximately 178,000 acre-feet per year. The City provides water to the South Texas Water Authority (STWA), Alice Water Authority, Beeville, Port Aransas, Rockport, Mathis, Three Rivers, San Patricio County MWD No.1, Lamar Peninsula and the industrial complexes on the Corpus Christi Channel. The Port of Corpus Christi Authority has a contract with the Lavaca-Navidad River Authority to purchase water from Lake Texana and transport it to Corpus Christi. Conveyance facilities are now being constructed by the City. Expansion of the wastewater reuse system is not a viable option. The City receives credit for reuse water that is added to the bay system in the area. Any wastewater that is not discharged into the bay and used for other purposes would have to be made up from the reservoirs upstream of the City; therefore, the City is considered to have limited reuse potential. The Board has identified additional supplies that could partially meet Corpus Christi's water problems. These include the completion of the conveyance facilities to transport water from Lake Texana to Nueces County by 2010, and construction of the proposed conveyance to transport water from Garwood Irrigation District in the Colorado Basin to Nueces County by 2040. In both cases, construction of major conveyance facilities is required.

**Kingsville.** Kingsville purchases its water from the City of Corpus Christi and the STWA. The City's current contract provides for enough water to supply its needs through 2050, but the contract will expire in 2004 and will need to be renegotiated. System improvements to the City's water treatment facilities are needed to comply with the Safe Drinking Water Act. It is anticipated that the City will apply for and receive funding for the necessary improvements.

**Beeville.** Beeville's water supply is purchased from the City of Corpus Christi. The City has a contract to purchase up to 16,813 acre-feet of water. The present supplies, along with an effective water conservation program, should meet the City's water needs through 2050.

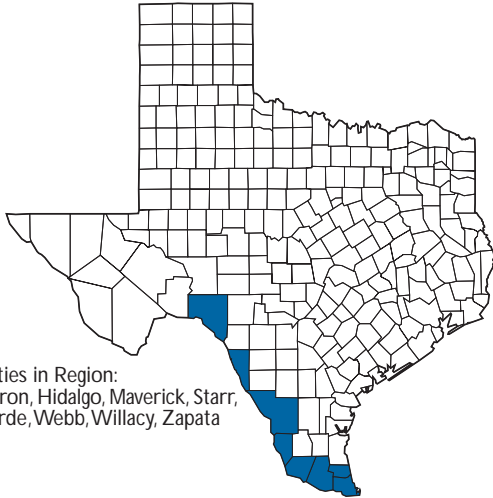
**Alice.** The City of Alice owns Lake Alice, which provides a portion of their water supply. The lake alone does not satisfy the needs of the City, and additional supplies are purchased under contract with the City of Corpus Christi from the Choke Canyon-Lake Corpus Christi System. The contract allows the purchase of up to 10% over the previous year's purchase.

**Refugio.** The City of Refugio gets 100% of its water supply from the Gulf Coast Aquifer. The water quality is generally good, but that may be compromised in the future in the event that salt-water intrudes into the aquifer. As long as the water quality is not affected by excessive pumping, the present supplies, along with an effective water conservation program, should meet the City's water needs through 2050.

**Ingleside.** The City of Ingleside purchases water from the San Patricio MWD. The present supplies, along with an effective water conservation program should meet the City's water needs through 2050.

# Lower Rio Grande Region

## Location Of Region



Counties in Region:  
Cameron, Hidalgo, Maverick, Starr,  
Val Verde, Webb, Willacy, Zapata

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Laredo	157,559	431,591
• Brownsville	127,682	248,777
• McAllen	98,847	206,280
• Harlingen	53,609	104,330

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Food & Kindred
- Textile Mill Products
- Stone, Clay & Glass
- Transportation Equip.

### Major Irrigated Crops

- Cotton
- Vegetables
- Corn
- Sorghum

Figure 3-26

## Historical and Projected Population and Water Use

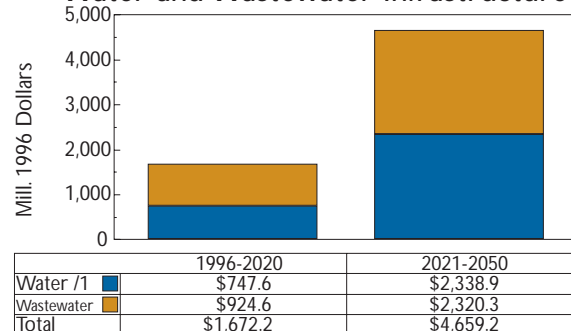
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	919,505	1,598,851	2,403,624	3,020,871	228.5%
% of State Total	5.41%	6.81%	7.84%	8.24%	-----
Municipal Water Use	187,839	312,439	415,970	508,814	170.9%
Industrial Water Use/1	11,036	13,132	15,047	16,355	48.2%
Agricultural Water Use/2	1,358,284	1,354,031	1,254,706	1,162,737	-14.3%
Irrigation Adjustment /3	0	(188,366)	(194,992)	(208,040)	-29.8%
Total Water Use	1,557,159	1,491,236	1,490,731	1,479,866	-4.9%
% of State Total	9.90%	9.42%	10.09%	9.92%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Del Rio	12,106	15,716
Laredo	46,536	95,722
McAllen	30,246	43,902
Edinburg	7,610	15,051
Harlingen	10,759	15,777
Brownsvl.	30,971	49,046

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.9 Lower Rio Grande Region

**Regional Description.** The Lower Rio Grande Region is comprised of 8 counties in the Rio Grande and Nueces river basins, and the Nueces-Rio Grande Coastal Basin. The region witnessed substantial population growth in the 1980's, increasing from 710,911 in 1980 to 919,505 in 1990. In the coming decades, the rapid growth trend in population is expected to continue as this region is projected to be one of the fastest growing population centers in the State. By 2050, the population in the Lower Rio Grande Region is projected to reach 3.0 million, or a 229 percent increase from 1990 to 2050. As a result, its share of the State's population is projected to increase from 5.4 percent in 1990 to nearly 8.3 percent in 2050.

While the region accounted for 5.4 percent of the State's total population in 1990, it accounted for almost 10 percent of the State's total water use. As one of the fastest growing population regions, municipal water use is projected to increase almost 171 percent from 1990 to 2050, while industrial water use is projected to increase by about 48 percent. However, based on the projected demand and supply conditions, water requirements for the region's agricultural sector are anticipated to decline by about 30 percent over the 1990-2050 planning period due primarily to insufficient quantities of water to meet anticipated irrigation water demands and assumed voluntary transfers of water. Since agricultural water use is by far the largest component in the region (87 percent), total water use is projected to decline slightly (about 5 percent) over the planning period.

Water savings due to conservation in the municipal sector are projected to save 85,000 acre-feet by 2020. These savings are anticipated to increase to 143,000 acre-feet by 2050. Conservation in agricultural irrigation, due to improved conveyance and application of water, is projected to save 141,000 acre-feet by 2020, and 236,000 acre-feet by 2050 over planning scenarios with no conservation.

**Regional Water-related Problems and Needs.** At present, municipal use comprises approximately 18 per cent of all water used in the region (both groundwater and surface water). By the year 2050, municipal use will comprise about 30 percent of all water used in the region. As the trend toward declining irrigation use and increasing municipal use continues, good planning will be needed to adapt the existing institutional framework to accommodate the trend. The Watermaster's Office of the TNRCC may continue to facilitate the marketing and transfer of water between uses as needed. The need for additional water treatment facilities will also increase.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Lower Rio Grande Valley Development Council.** Created by a unique merger between an economic development district (Texas Southmost Economic Development District) and a council of governments (Lower Rio Grande Valley Council of Governments), the LRGVDC provides

a forum for city and county elected officials to attempt to solve mutual problems on a cooperative basis. The LRGVDC covers Cameron, Hidalgo and Willacy counties and its concerns include comprehensive planning for water and environmental issues. The LRGVDC is sponsoring two studies which will impact the region. One study is to develop management plans for the Falcon-Amistad Reservoir system using Conditional Probability Analysis. The results will be included in the other study, a regional integrated resource plan (IRP) for Hidalgo, Cameron and Willacy counties.

**South Texas Development Council.** Created in 1966, this Council provides technical assistance and comprehensive regional planning services to member governments within Webb, Zapata, Jim Hogg and Starr counties. The STDC is sponsoring a regional integrated resource plan for the Laredo-Zapata area similar to the integrated resource plan described previously. The Laredo-Zapata integrated resource plan will also incorporate results of the management plan for the Falcon-Amistad Reservoir system.

**Watermaster Office of the Texas Natural Resource Conservation Commission.** The Watermaster Office of TNRCC, the state's water regulatory agency, administers the allocation of Texas' share of international waters of the Rio Grande. In this region the allocation involves water stored in international reservoirs Falcon and Amistad. The allocation must follow the international treaty entered into by the United States and Mexico as well as following the Texas court decision which adjudicated the Lower Rio Grande Basin. Both municipalities and irrigators have water rights to the Falcon-Amistad Reservoir system; the Watermaster allocates the proper amounts to the various water right holders and facilitates marketing of water rights.

**Economically Distressed Areas Program (EDAP).** The Texas Water Development Board administers EDAP funds to qualifying municipalities and districts. The region has been the recipient of some \$37.5 million of EDAP funding in the form of loans and grants which finance water and wastewater improvements in Cameron, Hidalgo, Maverick, Starr and Willacy counties. These improvements allow communities to tap into and effectively use the water supplies that are in the area and, in some instances, improve hygiene and health of the populace.

**Del Rio.** The City of Del Rio's water demands will continue to be met with groundwater from the Edwards-Trinity Plateau Aquifer throughout the 50-year planning period. The City's water and wastewater systems have benefited from EDAP funds.

**Laredo.** The City of Laredo's water demands will continue to be met throughout the 50-year planning period with Rio Grande water from the Falcon-Amistad Reservoir system. The City is authorized to divert this water through its current water right; however the City needs additional long-term supplies, probably through the purchase of irrigation water rights. The City is also studying the possibility of using Aquifer Storage and Recovery (ASR) technology to reduce peak demands on its water system.

**McAllen and Edinburg.** These cities' water demands will continue to be met throughout the 50- year planning period with Rio Grande waters from the Falcon-Amistad Reservoir system. The cities are authorized to divert this water through current water rights; however the cities

need additional long-term supplies, probably through the purchase of irrigation water rights. The City of Edinburg's water system has benefited from EDAP funds, and also is pursuing an application for DWSRF funding through the Safe Drinking Water Act.

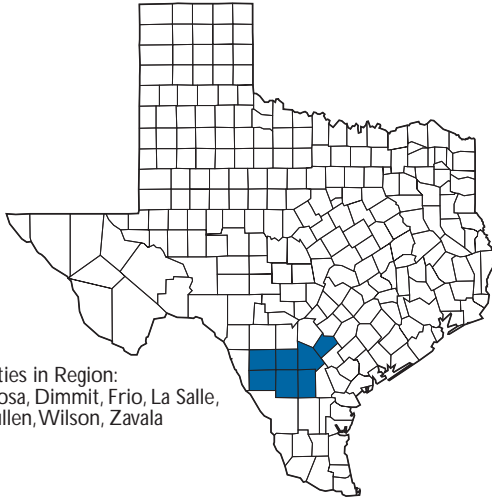
**Harlingen.** The City of Harlingen's water demands will continue to be met throughout the 50-year planning period with Rio Grande waters from the Falcon-Amistad Reservoir system.

**Brownsville.** The City of Brownsville's water demands will continue to be met through year 2010 with Rio Grande waters from the Falcon-Amistad Reservoir system. Supplies may be supplemented after that time with Rio Grande flood water from the recommended Channel Weir Dam at Brownsville. The City has performed extensive ground-water studies 25 miles west of Brownsville and could supplement its water supply from this source. The City has done preliminary feasibility studies on the possibility of an Aquifer Storage and Recovery (ASR) project. The City is also considering reverse osmosis desalination technology. The City's water and wastewater systems have benefited from EDAP funds. The City continues to purchase additional water rights and requires new developers to either provide their own water or pay a water rights charge to the City.



# Winter Garden Region

## Location Of Region



Counties in Region:  
Atascosa, Dimmit, Frio, La Salle,  
McMullen, Wilson, Zavala

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Pleasanton	8,472	15,307
• Crystal City	8,279	10,140
• Pearsall	7,713	10,979

/1 State Data Center    /2 TWDB

### Major Water-Using Industries

- Stone, Clay & Glass
- Food & Kindred
- Textile Mill Products

### Major Irrigated Crops

- Corn
- Cotton
- Hay/Alfalfa

Figure 3-27

## Historical and Projected Population and Water Use

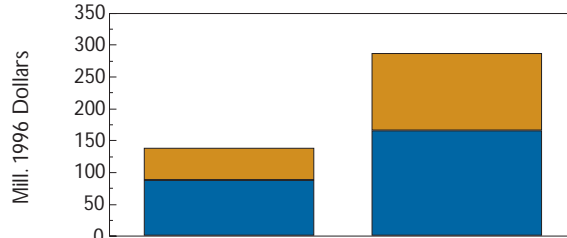
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	95,321	125,946	151,612	173,021	81.5%
% of State Total	0.56%	0.54%	0.49%	0.47%	-----
Municipal Water Use	18,359	25,704	28,879	32,333	76.1%
Industrial Water Use/1	9,552	16,666	16,960	27,492	187.8%
Agricultural Water Use/2	281,233	254,589	233,496	214,565	-23.7%
Irrigation Adjustment /3	0	(111,104)	(147,962)	(133,726)	-73.4%
Total Water Use (ac-ft)	309,144	185,855	131,373	140,664	-54.5%
% of State Total	1.97%	1.17%	0.88%	0.94%	-----

1/ Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Crystal City	2,113	2,090
Carrizo Spr.	2,396	4,530
Cotulla	941	1,131
Floresville	1,337	1,756
Lytle	652	904
Pleasanton	2,306	3,429

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$87.1	\$166.1
Wastewater	\$51.4	\$120.7
Total	\$138.5	\$286.8

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.10 Winter Garden Region

**Region Description.** The Winter Garden Region derives its name from the large amount of fall or winter irrigated crops produced in the region. The region consists of 7 counties in the Nueces, Guadalupe, and San Antonio River basins. From 1980 to 1990, the region experienced moderate growth in population, increasing 12.2 percent from 84,932 to 95,321. The region is expected to grow more rapidly over the planning period, increasing to about 173,000 by 2050. The region accounts for less than one percent of the State's total population.

Total water use for the region was about 309,000 acre-feet in 1990, and is projected to decrease to about 141,000 by 2050, a decrease of about 55 percent. Much of the decline can be attributed to reduction in water used for irrigated agriculture, resulting primarily from estimated insufficient quantities of groundwater to meet current and projected irrigation water demands for the region. By 2050, municipal water use is expected to increase about 76 percent, while water requirements for the regional industrial sector are also projected to increase.

Under the selected planning scenario, conservation practices in the municipal, manufacturing, and agricultural sectors are projected to save almost 15,000 acre-feet by 2020. By 2050, these savings are projected to be about 21,000 acre-feet over scenarios with no conservation.

**Regional Water-related Problems and Needs.** Pumping from the Carrizo-Wilcox Aquifer in the western part of the region has lowered water levels more than 100 feet since 1930 and over 250 feet in the Crystal City area. Localized water quality problems, due to well construction and water-level declines, have occurred in this area. In the eastern part of the region, water-level declines of 50 feet have occurred in the past decade. Declining water levels have led the Evergreen Underground Water Conservation District to impose pumping limits and well spacing restrictions. Ground-water levels will continue to decline in the region and users of this resource will have to lower the pumps in the wells or locate well in areas where the declines have not been as great.

One concern in the region is the potential for increased use of Winter Garden water supplies to meet demands from the neighboring Edwards Region. Reduced availability of water from the Edwards Aquifer could cause cities to look to the Winter Garden Region for additional municipal supplies, or cause farmers presently using the Edwards Aquifer to relocate to the region and increase irrigation demands on the Carrizo-Wilcox Aquifer.

Little surface water is used in the region at the present time other than that provided by Zavala-Dimmit WID#1 from the Nueces River. Flooding and maintenance of diversion facilities has been a problem for the surface water users. In the eastern part of the region, river water quality and localized flooding are concerns.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Evergreen Underground Water Conservation District (EUWCD).** The District was created in 1965 but did not become fully active until April, 1985. The District encompasses all of Atascosa, Frio and Wilson counties. The District has a management plan that establishes policy in technical research, water conservation, regulation, permitting and enforcement, in cooperation and coordination with the water users of the District. The District recently passed production limits for new permitted wells or existing wells that are modified to increase production. The plan prescribes a production ratio of ground-water withdrawal based upon the number of acres of land owned by the well owner.

**Nueces River Authority (NRA).** Established in 1935, NRA provides management of the surface water resources for all of the region except Wilson and Karnes counties. The Authority is a sponsor of the Choke Canyon project which was built to provide water to Corpus Christi and other cities outside of the region. The Authority has participated in a number of local planning studies and one regional study for water supply and water quality. The NRA is also the lead agency for the Clean Rivers program in the Nueces River Basin.

**San Antonio River Authority (SARA).** SARA provides water planning and management for Wilson and Karnes counties. The Authority has been the lead agency in many regional studies and provides laboratory and surface water quality monitoring services for Wilson and Karnes counties. The Authority would most likely be the lead sponsor for the Cibolo Creek project that is recommended for development by 2010. The project would be constructed in Wilson County on Cibolo Creek (see project description in the San Antonio River Basin section for further details) and could be used to meet needs in Wilson and Karnes counties.

**Zavala-Dimmit Counties WID#1.** The District provides irrigation water to 14,000 acres in Zavala and Dimmit counties from a series of small lakes on the Nueces River.

**Alamo Area Council of Governments.** The council has participated in some local planning studies evaluating infrastructure needs for Frio, Wilson, Karnes and Atascosa counties and is developing GIS databases of water resources information for those counties.

**Middle Rio Grande Development Council.** The members of the development council have established a water council to coordinate and consider water issues and problems within the counties of the development council including Zavala, Dimmit and La Salle.

**Economically Distressed Areas Program (EDAP).** Funds from the EDAP program, administered by TWDB, have been used by Dimmit County to improve the water system for Catarina. The region has been the recipient of \$739,631 in the form of grants and loans.

**Crystal City.** The City will continue to rely on groundwater, but may have to develop additional supplies outside of the City.

**Carrizo Springs.** The City will continue to depend on the Carrizo-Wilcox Aquifer.

**Cotulla.** The City will continue to use the Carrizo-Wilcox Aquifer.

**Floresville.** If the City needs to develop additional wells and if it does not develop them within its service area, then the City would have to obtain enough land to comply with Evergreen UWCD's capacity restriction that requires one acre of land for every 2.5 acre-feet of water needed.

**Lytle.** The City uses water from the Edwards (BFZ) Aquifer and will have to follow the management plans of the Edwards Aquifer Authority. The plan could call for the reduction in the use of Edwards Aquifer water. If this occurs, then Lytle would either have to get a surface water source or use groundwater that could fall under the control of the Evergreen District. The District's management plan calls for control of one acre of land for every 2.5 acre feet of groundwater needed.

# Southern Edwards Region

## Location Of Region



Counties in Region:  
Bexar, Caldwell, Comal, Guadalupe,  
Hays, Kinney, Medina, Uvalde

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• San Antonio	1,065,384	2,394,753
• San Marcos	33,918	81,831
• New Braunfels	32,252	110,577
• Seguin	20,606	41,181

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Chem. & Allied Products
- Stone, Clay & Glass
- Food & Kindred
- Textile Mill Products

### Major Irrigated Crops

- Peanuts
- Hay
- Pecans
- Wheat

Figure 3-28

## Historical and Projected Population and Water Use

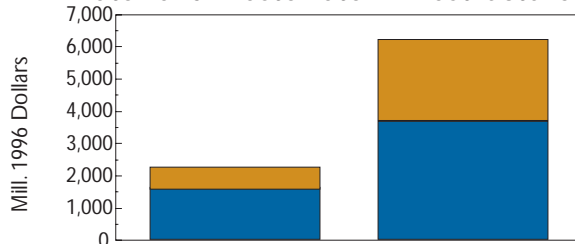
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	1,447,876	2,221,358	3,166,695	3,974,232	174.5%
% of State Total	8.52%	9.46%	10.37%	10.84%	-----
Municipal Water Use	273,980	427,572	565,732	694,005	153.3%
Industrial Water Use/1	47,448	73,938	89,913	106,090	123.6%
Agricultural Water Use/2	355,143	323,086	298,112	275,088	-22.5%
Irrigation Adjustment /3	0	(141,134)	(201,004)	(196,099)	-79.7%
Total Water Use	676,571	683,462	752,753	879,084	30.0%
% of State Total	4.30%	4.32%	5.09%	5.89%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
San Antonio	220,405	391,640
San Marcos	8,431	17,691
N. Braunfels	10,410	25,888
Seguin	4,197	7,288
Uvalde	5,173	7,871
Hondo	2,032	2,393

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$1,633.9	\$3,686.6
Wastewater	\$728.9	\$2,538.1
Total	\$2,362.8	\$6,224.7

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.11 Southern Edwards Region

**Regional Description.** The Southern Edwards Region is comprised of 8 counties in the Nueces, Rio Grande, San Antonio, Guadalupe, and Colorado river basins. From 1980 to 1990, the Southern Edwards Region experienced rapid population growth, increasing 22 percent. This growth trend is projected to continue over the coming decades, making the region one of the fastest growing regions in the State. The population is projected to grow from about 1.45 million in 1990 to approximately 3.97 million in 2050, an increase of about 175 percent.

The Southern Edwards Region used about 677,000 acre-feet of water in 1990, with irrigated agriculture accounting for more than 50 percent of the region's water use. By 2010, irrigated agriculture will be surpassed by municipal water use as the predominant water use category in the region. Municipal water use is projected to increase about 153 percent from 1990 to 2050, while agricultural water use is anticipated to decline significantly due to estimated reductions in ground-water availability for irrigation purposes, regulatory constraints on total pumpage, and assumed voluntary transfers of water. Industrial use is anticipated to increase by more than 123 percent over the 1990 to 2050 period. Overall, total water use for the region is projected to increase about 30 percent.

Under the planning scenario, conservation efforts in the municipal sector are projected to save 108,000 acre-feet of water by 2020. As water use increases, these savings are projected to increase to 179,000 acre-feet. In the manufacturing sector, conservation is projected to save almost 2,000 acre-feet by 2020 and approximately 4,000 acre-feet by 2050 over scenarios with no conservation.

**Regional Water-related Problems and Needs.** Rapid growth of urban areas is straining the existing water supply and waste-disposal facilities. Recent droughts and lawsuits brought by the Sierra Club to protect the spring flows at Comal and San Marcos springs, have forced restrictions on water use during the dry summer months. Furthermore, continued high capacity pumping from the Edwards Aquifer could potentially allow the "bad-water" line to encroach into the southernmost extent of the aquifer, which may affect the potability of the aquifer water in the future. Development of alternative water supplies is needed to "firm-up" municipal supplies and reduce reliance on the Edwards Aquifer in critical drought periods. Increased use of surface water would also assist in maintaining the ecosystems and recreational opportunities on San Antonio, Hueco, Comal and San Marcos springs, and the base flow of the streams to the south of the aquifer.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Guadalupe-Blanco River Authority (GBRA).** GBRA is a regional entity serving Hays, Comal, Guadalupe, Caldwell, Gonzales, De Witt, Victoria, Kendall, Refugio, and Calhoun counties. The Authority provides water to New Braunfels and has contracted to provide water to San

Marcos from Canyon Reservoir. With the subordination of the hydro-power rights below Canyon Reservoir and the conversion to firm water rights out of Canyon, approximately 35,000 acre-feet of additional supplies can be made available for the region. The Authority could also provide water to the region by developing facilities near Gonzales to divert surplus flows of the Guadalupe River into the region. The GBRA could also serve as the sponsor for the proposed Sandies Creek Reservoir, which could serve the region as a new water supply source.

**Edwards Aquifer Authority (EAA).** The Authority was formed by the Texas Legislature in 1995. The legislation creating the Authority also instituted withdrawal limits of 450,000 acre-feet per year through 2007, at which time the limit is reduced to 400,000 acre-feet until December 31, 2012. After 2012 the Authority, through various practices, shall ensure the maintenance of continuous minimum spring flows at Comal and San Marcos springs to protect the endangered and threatened species to the extent required by federal law. Withdrawal limits will require users of the Edwards (BFZ) Aquifer to seek additional water supply sources. To increase the recharge to the Edwards (BFZ) Aquifer, the district will need to develop the recommended recharge structures in the Nueces, San Antonio and Guadalupe basins.

**San Antonio River Authority (SARA).** SARA was established in 1937 and provides water planning and management for Bexar, Goliad, Wilson, and Karnes counties. The Authority would mostly like be the lead sponsor for the Cibolo Creek project that is recommended for development by 2010. The project would be constructed in Wilson County on Cibolo Creek (see project description in the San Antonio River Basin section for further details) and used to meet water supply needs in Bexar County and possibly other counties served by SARA.

**Bexar-Medina-Atascosa WCID No. 1 (BMA).** BMA is the owner of the oldest surface water project in the State that is still used for water supply. Lake Medina is permitted for municipal supply, but is mainly used to supply irrigation water to farmers in Bexar, Medina, and Atascosa counties. The lake and diversion facilities also recharge the Edwards (BFZ) Aquifer. Depending on its operation, the supply available from Lake Medina can range from zero up to 60,000 acre-feet per year. The District is authorized to sell water for municipal use, and the Board recommends that the District convert any surplus water to municipal supplies and blend it with groundwater in the Bandera County region. It can also be used to supplement other water supplies in Bexar County.

**Canyon Regional Water Authority (CRA).** Canyon Regional Water Authority is the water planning and development agency for nearly all of Guadalupe County, and portions of Bexar, Hays, Wilson, and Comal counties. The Authority also owns and operates a treatment plant at Lake Dunlap on the Guadalupe River. The Authority's sources of supply include surface water purchased from GBRA and groundwater pumped from the Edwards (BFZ) Aquifer. The Authority is encouraging development of alternative sources for users not located directly over the aquifer. It is anticipated that needs in the Authority's area will be met by the GBRA and additional surface water supplies developed for the entire region.

**Bexar Metropolitan Water District (Bexar Met).** Bexar Met provides water to the west and northwest portions of Bexar County and some areas of San Antonio from the Edwards

(BFZ) Aquifer. The District has a surplus water supply contract with BMA for water from Lake Medina. It is recommended that the District convert the surplus contract to a full use contract. The District is investigating the use of Aquifer Storage and Recovery (ASR) to store surplus water supplies from Lake Medina and if this option proves feasible, the District should pursue it.

**San Marcos.** San Marcos' water supply is groundwater from the Edwards (BFZ) Aquifer. The City is working on the preliminary phases of a surface water treatment plant and also purchased the K&H Water Supply Corporation in 1996. The Board's projections indicate that San Marcos will need to fully develop its surface water capabilities. The Board recommends the construction of a conveyance from Canyon Reservoir to Hays County by 2005 to avoid critical shortages. With increased surface water supplies and an effective conservation program, the City will be able to meet its needs through 2050.

**New Braunfels Utilities.** The City of New Braunfels already uses water from Canyon Lake in conjunction with groundwater from the Edwards (BFZ) Aquifer. However, as the area continues to develop, New Braunfels Utilities will need to obtain additional supplies from the reservoir and gradually move away from ground-water usage completely. With increased surface water supplies and an effective conservation program, the utility will be able to meet its needs through 2050.

**San Antonio Water System (SAWS).** San Antonio is the largest city in the region and its sole water supply source is the Edwards-Balcones Fault Zone Aquifer. SAWS is evaluating other supply alternatives, including surface water development of Sandies Creek and Cuero reservoirs in the Guadalupe Basin, Goliad and Cibolo reservoirs in the San Antonio Basin, other potential new reservoirs or ground-water sources, reuse of wastewater, purchase of previously-developed supplies, recharge enhancement or various combinations of these alternatives. This evaluation is being done in cooperation with other area districts and water suppliers. The Board recommends the expansion of the City's reuse program, the construction of a conveyance from the Guadalupe River to Bexar County by 2010, development and conveyance of water supplies from the proposed Cibolo Reservoir by 2015, development and conveyance of Carrizo-Wilcox well fields in Bastrop, Lee and/or Gonzales counties, and development and conveyance from the proposed Sandies Creek Reservoir by 2030. Further investigation of the use of Aquifer Storage and Recovery (ASR) techniques is also recommended. With developed alternative water supplies and an effective conservation program, SAWS will be able to meet its needs through 2050.

**Bexar County.** Users of Edwards (BFZ) Aquifer water throughout the County will have to comply with the management plan for the Edwards Aquifer that calls for reductions in pumpage from the aquifer. As these reductions occur, the users will have to find alternative sources of water supply. The Board recommends the expansion of reuse programs, the construction of a conveyance from the Guadalupe River to Bexar County by 2010, development and conveyance of water supplies from the proposed Cibolo Reservoir by 2015, development and conveyance of Carrizo-Wilcox well fields and development and conveyance from the proposed Sandies Creek Reservoir by 2030. With developed alternative water supplies and an effective conservation program, the County will be able to meet its needs through 2050.



**Seguin.** The City of Seguin obtains water from the Guadalupe River and does not use any groundwater. The supply of surface water is projected to fulfill the needs of Seguin through 2050. Seguin also has a contract with the Guadalupe-Blanco River Authority to purchase 2,000 acre-feet annually from Canyon Lake to ensure that ample supplies are available during drought conditions. The present supplies, along with an effective water conservation program should meet the City's water needs through 2050.

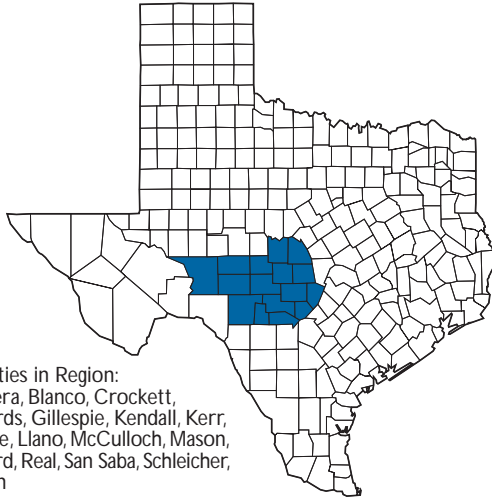
**Uvalde.** Current projections indicate that the City of Uvalde should remain on ground-water supplies from the Edwards-Balcones Fault Zone Aquifer to fulfill its needs through 2050. Depending on the amount of water permitted by the EAA, the City may need to purchase additional Edwards Aquifer water.

**Hondo.** The City of Hondo gets its water from the Edwards-Balcones Fault Zone Aquifer and should not experience any shortages through 2050, assuming the City is permitted to pump sufficient water by the EAA.

**Barton Springs/Edwards Aquifer Conservation District (BS/EACD).** The District's jurisdictional area encompasses 255 square miles in Travis, Hays, Bastrop, and Caldwell counties. Groundwater pumpage is primarily from the Edwards Aquifer. However, some wells also produce water from the Taylor, Glen Rose, and Trinity Formations, as well as various alluvial deposits along stream banks. All wells within the District's jurisdictional boundary capable of producing at least 10,000 gallons per day are required to be permitted with the District. The 10,000 gallon/day provision is provided for the District's enabling legislation to address the fragile environment within the Barton Springs/Edwards Aquifer.

# Hill Country Region

## Location Of Region



Counties in Region:  
Bandera, Blanco, Crockett,  
Edwards, Gillespie, Kendall, Kerr,  
Kimble, Llano, McCulloch, Mason,  
Menard, Real, San Saba, Schleicher,  
Sutton

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Kerrville	20,153	37,285
• Fredericksburg	8,192	13,073
• Brady	5,946	5,740
• Boerne	5,694	12,435

/1 State Data Center /2 TWDB

### Major Water-Using Industries

- Electronic & Other Equip.
- Stone, Clay & Glass
- Industrial & Commercial Machinery Equip.

### Major Irrigated Crops

- Pecans
- Hay
- Forage Crops

Figure 3-29

## Historical and Projected Population and Water Use

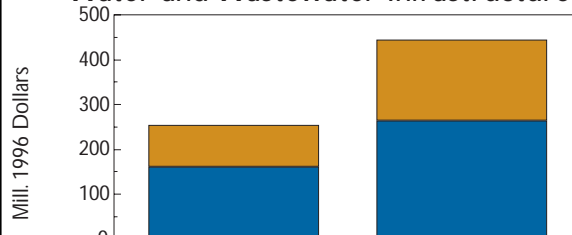
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	136,119	175,383	212,514	240,329	76.6%
% of State Total	0.80%	0.75%	0.69%	0.66%	-----
Municipal Water Use	25,986	33,420	36,367	39,382	51.6%
Industrial Water Use/1	6,213	8,267	8,469	9,079	46.1%
Agricultural Water Use/2	46,555	45,839	44,305	42,848	-8.0%
Irrigation Adjustments /3	0	0	0	0	-----
Total Water Use	78,754	87,526	89,141	91,309	15.9%
% of State Total	0.50%	0.55%	0.60%	0.61%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Brady	1,928	1,678
Llano	1,060	1,002
Fredericksb.	2,056	2,958
Kerrville	5,339	7,267
Blanco	293	236
Boerne	1,168	2,173

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$160.5	\$262.5
Wastewater	\$92.4	\$181.8
Total	\$252.9	\$444.3

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.12 Hill Country Region

**Region Description.** The Hill Country Region is made up of 16 counties in the Nueces, Rio Grande, Guadalupe, San Antonio, and the Colorado River basins. In 1980, the population of the region was 116,947. By 1990, the regional population grew 16 percent to 136,119. Population growth is expected to continue throughout the planning period as population is projected to increase about 77 percent from 1990 to 2050.

The region represented 0.8 percent of the State's total population in 1990 and 0.5 percent of the State's water use. Water used for agriculture is the predominant category in the region, using nearly 47,000 acre-feet in 1990. Water use in this sector is projected to decline slightly over the planning period to about 43,000 acre-feet by 2050. Water uses for municipal and industrial purposes, however, are projected to increase about 52 percent and 46 percent respectively from 1990 to 2050. Overall, water use in the region is projected to increase nearly 16 percent over this same period of time.

Under the selected planning scenario, conservation efforts in the municipal sector are projected to save approximately 6,000 acre-feet by 2020 over scenarios with no conservation. As water use increases, conservation is projected to save 8,700 acre-feet by 2050. Most of the savings are projected to come from improved water efficiency of indoor plumbing fixtures and from improved outdoor watering practices in the municipal sector.

**Regional Water-related Problems and Needs.** Declining water levels and/or poor quality groundwater confront many of the communities and rural areas of the Hill Country Region. Because of the relatively poor hydraulic characteristics of the aquifers of the region, increases in demands for water, and the inability or unwillingness of most of the public water systems to adjust to these conditions by obtaining additional lands for proper spacing of additional wells, only a portion of the aquifers' ground-water production potential is achieved to meet public water needs. A better understanding of the local hydraulic nature of the aquifer in the design and siting of water wells is needed to better manage available ground-water supplies. Also, conjunctive use of groundwater and available surface water supplies is recommended as a means of extending limited ground-water supplies and improving water quality. Although designated as a "critical" water availability area by the TNRCC, the State has yet to initiate creation of underground water conservation districts. Three underground water conservation districts, Hill Country UWCD in Gillespie County, Headwaters UWCD in Kerr County, and Springhills Water Management District in Bandera County, have been formed in the area from public initiation. All three districts have submitted comprehensive management plans with the TNRCC, but only the Hill Country UWCD has well spacing and production regulations. Additional discussion of specific ground water problems and suggested solutions are discussed in the Trinity Aquifer section.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of major urban areas and large utility suppliers in the Hill Country Region is described below. Additional data may be obtained from the Board's files.

**Upper Guadalupe River Authority (UGRA).** The Upper Guadalupe River Authority serves the Kerr County area and holds permits for 7,772 acre-feet of water per year from the Guadalupe River. The UGRA also has a permitted Aquifer Storage and Recovery (ASR) project to inject treated surface water into the strata of the Trinity Aquifer for later use during periods of peak demands, with no losses due to evaporation.

**Brady.** Water supplies for the City of Brady are presently met by ground-water wells completed into the Hickory Aquifer; however, there have been problems in the past with this water supply not meeting the Safe Drinking Water Act standards for radioactivity. The City also holds water permits for surface water supplied from Lake Brady, but has yet to use this source as a water supply. Projections indicate that these supplies can meet demands for the City through the year 2050.

**Llano.** Water supplies for the City are provided by the Llano River. Projections indicate that these supplies, in conjunction with water supplied by the LCRA from the Highland Lakes, will meet all future demands by the City through the year 2050.

**Fredericksburg.** Water supply for the City is presently provided by ground-water wells completed into the Ellenberger-San Saba Aquifer. Projections indicate that this supply will continue to meet the City's demands through the year 2050.

**Kerrville.** The City is supplied treated water under contract with the UGRA and groundwater from wells completed into the Trinity Aquifer. Projections indicate that these supplies will meet demands by the City through the 2050 planning year.

**Blanco.** The City of Blanco's water supply is obtained from the Blanco River. During periods of insufficient flow in the river, supplies are augmented by ground-water wells completed into the Trinity Aquifer. Projections indicate that these supplies will meet the City's water demands through 2050.

**Boerne.** The supply for the City is met by groundwater withdrawn from the Trinity Aquifer and from surface water supplied by Boerne City Lake. The City has purchased water supplies out of Canyon Lake from GBRA. Projections indicate that demand by the City will be met by these existing supplies through the year 2050.

**Springhills Water Management District.** The District's problems mirror those experienced by a larger region north of the San Antonio metropolitan area, where primary dependence on groundwater, declines in the Trinity-Plateau Aquifer level, and diminished municipal water supplies, especially during hot weather, have resulted in the designation of the Hill Country Critical (groundwater) Area. The District feels that the conjunctive use of ground and surface water should be accomplished through acquisition of water rights or supplies from Lake Medina.

**Emerald Underground Water Conservation District.** The District was created in 1991 by Senate Bill 1635, and encompasses most of Crockett County. The District also has a ground-water management plan and its activities include well permitting, well spacing requirements,

water quantity/quality monitoring and management, as well as participation in regional conservation and recharge enhancement projects.

**Sutton County Underground Water Conservation District.** The District was created in 1986 by House Bill 1161 and Chapters 51 and 52 of the Texas Water Code. The District encompasses most of Sutton County, has a ground-water management plan, and participates in many conservation activities. Its activities also include well permitting, well spacing requirements, water quantity/quality monitoring and management, as well as participation in regional conservation projects. Additional activities include production regulations that require permitting of high capacity water wells, participation in well head protection, and a drought contingency program.

**Plateau Underground Water Conservation District.** The District was created in 1965 by the 62nd Legislature, and encompasses all or portions of Schleicher, Irion, Tom Green, Menard and Sutton counties. The District has a ground-water management plan and participates in many conservation activities. Its other activities include well permitting, well spacing requirements, water quantity/quality monitoring and management, as well as participation in regional conservation and recharge enhancement activities.

# Austin Region

## Location Of Region



Counties in Region:  
Bastrop, Burnet, Travis, Williamson

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Austin	547,677	1,341,671
• Round Rock	45,806	197,694
• Georgetown	19,706	88,233

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Electronic & Other Equip.
- Stone, Clay & Glass
- Industrial & Commercial Machinery Equip.

### Major Irrigated Crops

- Pecans
- Hay
- Forage Crops

Figure 3-30

## Historical and Projected Population and Water Use

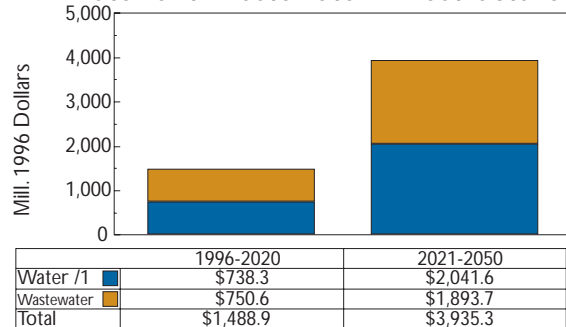
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	776,898	1,332,897	2,049,028	2,504,530	222.4%
% of State Total	4.57%	5.67%	6.68%	6.83%	-----
Municipal Water Use	149,225	278,806	396,011	475,903	218.9%
Industrial Water Use/1	19,782	32,543	35,412	42,424	114.5%
Agricultural Water Use/2	6,606	6,157	5,925	5,739	-13.1%
Irrigation Adjustment /3	0	0	0	0	-----
Total Water Use (ac-ft)	175,613	317,506	437,348	524,066	198.4%
% of State Total	1.12%	2.01%	2.96%	3.51%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Austin	148,865	287,047
Round Rock	3,364	40,303
Georgetown	5,508	16,110
Taylor	3,01	7,409
Bastrop	1,053	2,132
Burnet	750	1,099

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.13 Austin Region

**Region Description.** The Austin Area is composed of four counties in the Colorado, Brazos, and Guadalupe River basins. The region has experienced rapid population growth, increasing from 538,623 in 1980 to 776,898 in 1990. This trend is expected to continue as the region's population is expected to grow to about 2.5 million by 2050. The region comprised 4.6 percent of the State's population, and accounted for 1.1 percent of the State's total water use in 1990.

The Austin Area used a total of nearly 176,000 acre-feet of water in 1990, of which about 84 percent was for municipal purposes. Municipal water use is projected to increase from 149,225 acre-feet in 1990 to nearly 476,000 acre-feet in 2050. Industrial water use is projected to more than double over the planning period, increasing from 19,782 acre-feet in 1990 to more than 42,000 acre-feet by 2050. Agricultural water use is projected to decline slightly. Overall, total water use in the region is projected to increase significantly over the planning period.

By 2020, conservation efforts in the municipal sector are projected to save approximately 56,000 acre-feet under the selected planning scenario. By 2050, these savings are projected to amount to approximately 96,000 acre-feet over scenarios with no conservation.

**Regional Water-related Problems and Needs.** The Austin region has experienced rapid growth. Supplies available to the region are adequate to meet its needs with the development of transmission facilities to deliver water from Stillhouse Hollow and Belton reservoirs to Williamson County, and additional treatment facilities to treat Lake Travis water. The transfer of water from Lake Belton is a planning assumption based on the future (presumed) availability of water in Lake Belton and local consent to sell excess water. This option has not been locally endorsed. The City of Austin is investigating the use of aquifer storage and recovery as a tool to delay the construction of additional treatment facilities. Growth in the small communities that rely on groundwater may require them to connect to surface water systems in the region.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Brazos River Authority (BRA).** BRA provides management of flood control operations in its reservoirs and has conservation storage for water supply in lakes Georgetown and Granger, which are owned by the Corps of Engineers. It also provides water supply and conservation using lakes with a combined total conservation storage capacity of over 2.1 million acre-feet, provides regional water and wastewater treatment service, maintains supervision of recreational lake use, and operates public access areas.

The lakes in which BRA has water in storage or whose water could possibly be used in the region are Belton, Stillhouse Hollow, Georgetown, and Granger. Water from reservoir storage not committed to local use is used to meet needs in other parts of the Brazos Basin (or in other basins) under BRA's plan for system operation.

**Lower Colorado River Authority (LCRA).** LCRA is a conservation and reclamation district created by the Legislature of the State of Texas in 1934. It is a governmental agency and corporate of the State without taxing power. Its statutory boundaries encompass a ten-county region from San Saba County downstream to Matagorda County. The LCRA operates six dams with hydroelectric generating capacity. Five of the dams (Buchanan, Inks, Alvin Wirtz, Max Starcke and Mansfield) are owned by the LCRA, and a sixth (Tom Miller) is leased from the City of Austin. These dams form the six reservoirs called the Highland Lakes (lakes Buchanan, Inks, Lyndon B. Johnson, Marble Falls, Travis and Austin). By regulating discharge from the Highland Lakes, the LCRA contributes to flood control and sells water for municipal, irrigation, and industrial use in the Lower Colorado River Basin. The LCRA and the irrigation companies it owns 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 Authority is developing management plans that consider bay and estuary fresh water inflow needs, as well as any instream flow needs below Lake Travis. LCRA has contracts to provide water to Austin, Marble Falls, Cedar Park and a number of water districts in Travis County.

The Brazos-Colorado Water Alliance, a recent cooperative effort of the BRA and LCRA, will work toward identifying preferred alternatives to meet water and wastewater treatment needs in the region. A multi-year, multi-regional planning study for the area is nearing completion, and will recommend water supply options, also.

**Barton Springs/Edwards Aquifer Conservation District (BS/EACD).** The District's jurisdictional area encompasses 255 square miles in Travis, Hays, Bastrop, and Caldwell counties. Groundwater pumpage is primarily from the Edwards Aquifer. However, some wells also produce water from the Taylor, Glen Rose, and Trinity Formations, as well as various alluvial deposits along stream banks. All wells within the District's jurisdictional boundary capable of producing at least 10,000 gallons per day are required to be permitted with the District. The 10,000 gallon/day provision is provided for the District's enabling legislation to address the fragile environment within the Barton Springs/Edwards Aquifer.

**Aqua Water Supply Corp.** Aqua is a primary water service provider in the eastern portion of the region. Its service area is approximately 1,000 square miles, extending into Bastrop, Caldwell, Lee, Travis, and Williamson counties. It currently serves some 11,000 customers in this rapidly growing area of the State.

**Austin.** The City has rights to 165,000 acre-feet of water from the Colorado River. These rights, backed-up with water supplies from the LCRA and the purchase of additional supplies from LCRA, should meet the City's needs through 2050, assuming the City continues its active water conservation program.

**Round Rock.** The City will need to increase its available supplies by participating in the construction of the pipeline from Stillhouse Hollow Reservoir to Lake Georgetown. The City may also need to participate in the recommended Belton Reservoir pipeline and the purchase of water from Belton Reservoir by 2025, if this project proves feasible. This is a Water Plan recommendation based on the assumed future availability of excess water from Belton Reservoir



and consent by local contract holders. The Brazos-Colorado Water Alliance and a multi-year, multi-regional planning study are currently studying other water supply options for the entire area. These recommendations will proceed as approved and needed in the region.

**Georgetown.** The City will need to increase its available water supplies by participating in the construction of the pipeline from Stillhouse Hollow Reservoir to Lake Georgetown.

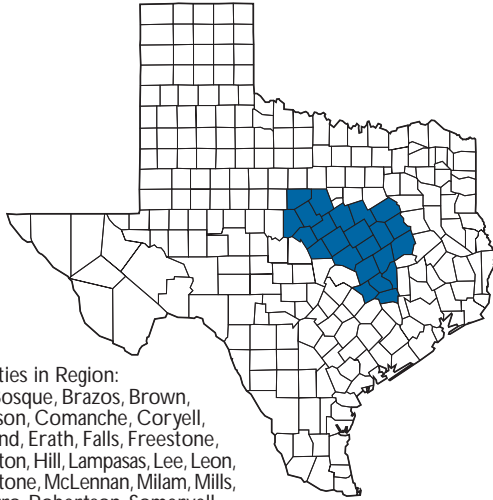
**Taylor.** The City will be able to meet its future needs from its contracted water supplies from Lake Granger.

**Bastrop.** The City should be able to meet its future needs from nearby ground-water resources.

**Burnet.** The City should be able to meet its future needs from the ground-water resources of the Elenburger-San Saba Aquifer.

# Heart of Texas Region

## Location Of Region



Counties in Region:  
 Bell, Bosque, Brazos, Brown,  
 Burleson, Comanche, Coryell,  
 Eastland, Erath, Falls, Freestone,  
 Hamilton, Hill, Lampasas, Lee, Leon,  
 Limestone, McLennan, Milam, Mills,  
 Navarro, Robertson, Somervell,  
 Washington

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Waco	108,192	192,621
• Killeen	78,616	138,064
• College Station	61,814	129,522
• Bryan	60,637	118,886
• Temple	49,489	61,189

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Primary Metal Industries
- Stone, Clay & Glass
- Food & Kindred

### Major Irrigated Crops

- Peanuts
- Cotton
- Hay

**Figure 3-31**

## Historical and Projected Population and Water Use

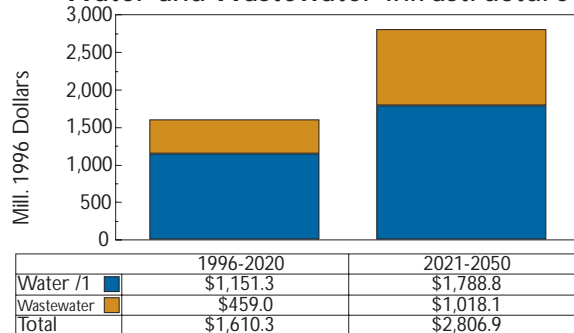
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	932,090	1,184,184	1,381,064	1,517,237	62.7%
% of State Total	5.49%	5.04%	4.50%	4.14%	-----
Municipal Water Use	164,573	214,124	233,191	252,966	53.7%
Industrial Water Use/1	80,334	149,215	176,125	207,075	157.8%
Agricultural Water Use/2	169,272	168,428	164,275	159,912	-5.5%
Irrigation Adjustment /3	0	(32,472)	(31,555)	(31,532)	-33.9%
Total Water Use	414,179	499,295	542,036	588,421	42.0%
% of State Total	2.63%	3.15%	3.67%	3.94%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Waco	27,698	39,053
Temple	12,212	12,063
Killeen	10,823	14,383
Bryan	11,572	19,043
College St.	18,224	36,561
Copperas C.	3,964	6,540

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.14 Heart of Texas Region

**Regional Description.** The Heart of Texas is comprised of 24 counties in the Brazos, Colorado, and Trinity River basins. The region experienced moderate population growth, increasing 14 percent from 814,636 in 1980 to 932,090 in 1990. Over the planning period, the region is projected to reach approximately 1.5 million people by 2050, an increase of nearly 63 percent. In 1990, the region represented about 5 percent of the State's population.

In 1990, the Heart of Texas Region used a total of about 414,000 acre-feet of water, accounting for 3 percent of the State's total water use. By 2050, total regional water use is projected to increase about 42 percent to approximately 588,000 acre-feet. Water for agriculture and municipal uses represented the largest water-use categories in the region in 1990, each using approximately 40 percent of the region's water. Municipal water use, however, is projected to increase about 54 percent by 2050, while water for agriculture is projected to decline about 34 percent due primarily to estimated insufficient quantities of ground water to meet current and projected requirements for irrigation purposes. Industrial water use is expected to be the fastest growing category over the 1990 to 2050 period.

Under the selected planning scenario, water conservation in the agricultural sector is projected to save 4,600 acre-feet by 2020, and approximately 9,000 acre-feet by 2050. Conservation savings in the municipal sector are projected to total 36,000 acre-feet by 2020, and 54,000 acre-feet by 2050 over scenarios that do not include conservation.

**Regional Water-related Problems and Needs.** Ground-water quality ranges from fresh in the Trinity and Carrizo-Wilcox aquifers to more highly saline in the downdip portions of these aquifers. Declining water levels in the Trinity Aquifer will necessitate conversion to surface water by some cities. Overall surface water quality is relatively good, but with localized areas of concern. Problems of low dissolved oxygen and elevated fecal coliform levels occasionally exist in the areas of municipal wastewater discharges. Frequent elevated fecal coliform and nutrient levels are a problem in the North Bosque River due primarily to nonpoint sources of pollution. Reallocation of flood control storage to consumptive water supply in Lake Waco was granted with the water right amendment that was obtained.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Trinity River Authority (TRA).** The Trinity River Authority, operating under a master plan originally adopted in 1958 and revised periodically, implements water supply and wastewater projects serving cities and special districts throughout the Trinity Basin. The portion of TRA's service area lying within the Heart of Texas region includes Navarro County and portions of Limestone, Freestone, Hill and Leon counties.

**Brazos River Authority (BRA).** The BRA was the first river authority established in the United States. Its activities include management of flood control operations; operation of wastewater collection and treatment systems; water quality and pollution control operations; and water supply and conservation. The two lakes owned and operated by BRA within this region are Granbury and Limestone. Lakes owned by the U.S. Army COE within the region are Waco, Proctor, Belton, Stillhouse Hollow, Georgetown, Granger, Somerville, Whitney and Aquilla. Water from reservoir storage not committed to local use is used to meet needs in other parts of BRA's service area under BRA's plan for system operation.

**Waco.** The City of Waco obtains water from Lake Waco. The enlarged Lake Waco is adequate to meet the City's demands throughout the planning period. BRA's regional wastewater treatment plant located in Waco has a capacity of 37.8 mgd.

**Temple-Belton.** Both of these cities obtain water from Lake Belton. The City of Belton also obtains water from Stillhouse Hollow Reservoir. The enlarged Lake Belton, along with Stillhouse Hollow, will be adequate to meet demands throughout the planning period. BRA's Temple-Belton regional wastewater treatment plant has recently expanded to 10 mgd.

**Killeen.** The City of Killeen obtains water from Lake Belton; the enlarged Lake Belton will adequately meet demands throughout the planning period. Bell County WCID #1's regional wastewater treatment plant is located in Killeen.

**Lampasas.** The City of Lampasas will continue to use its present local sources of water, and Stillhouse Hollow Reservoir water contracted from BRA to meet its demands throughout the 50-year planning period. The City recently received SRF funding from TWDB for construction of a new wastewater treatment plant and upgrading existing sewer lines.

**Gatesville.** The City of Gatesville's present source of supply, Lake Belton water contracted from BRA, will continue to meet its demands throughout the 50-year planning period. The City recently received EDAP funding from TWDB to install new wastewater collection lines and improve its Leon River wastewater treatment plant.

**Copperas Cove.** The City's present source of supply, Lake Belton water contracted from BRA, will continue to meet its demands throughout the 50-year planning period. The City recently received SRF funding from TWDB to upgrade and expand an existing wastewater treatment plant from 1 mgd to 2 mgd.

**Bryan-College Station.** Both of these cities currently obtain groundwater from the Carrizo-Wilcox Aquifer. Although the City of Bryan will continue to meet its demands with this groundwater, the City of College Station will need to make improvements to its infrastructure to meet its year 2030 demands. The TWDB is partially funding a water supply study for Brazos County that will address future water supply sources.

**Hillsboro.** The City of Hillsboro will continue to use its present source of water, Aquilla Creek Reservoir, throughout the 50-year planning period to meet its demands.

**Clifton.** The City of Clifton currently uses groundwater from the Trinity Aquifer. The City also holds a water right for surface water from the Bosque River and should fully utilize this right by 2020. The City is pursuing plans to construct an off-channel reservoir and pump station that will provide its future water supply.

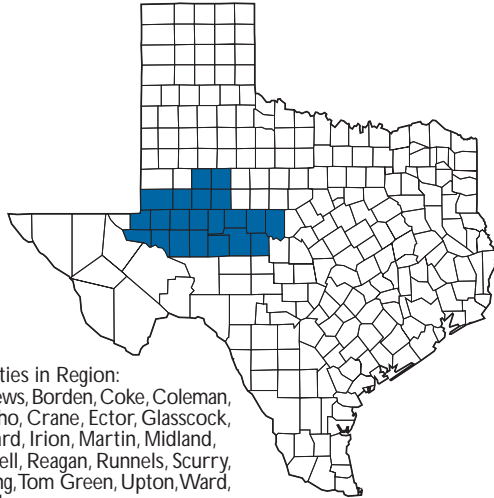
**Marlin.** The City of Marlin will need to obtain water from the New Marlin/Brushy Creek Reservoir system operation by year 2010. The City's current permit authorizes it to use New Marlin Reservoir and Marlin City Lake, both on Big Sandy Creek. The City has obtained authorization for an impoundment known as Brushy Creek Reservoir (also known as SCS Site No. 19 Tri-County Watershed Project Reservoir) on Brushy Creek. The City's amended permit allows for a variation on the City's current diversions such that New Marlin Reservoir and Brushy Creek Reservoir may both benefit from diversions from the Brazos River, while Marlin City Lake would be a sedimentation basin.

**Glen Rose and Stephenville.** Paluxy Reservoir is recommended to be built in order to satisfy the projected water demand in this area. Currently the area depends solely on groundwater and demand is projected to increase beyond the available supply by year 2010. The "Brazos River Basin" section contains a detailed discussion on Paluxy Reservoir.

**Cisco.** The City of Cisco currently uses surface water from Lake Cisco; however, since the City's recent demands exceed the lake's dependable yield of approximately 500 acre-feet per year, the City should consider contracting with the City of Abilene for additional water supplies.

# Upper Colorado Region

## Location Of Region



## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• Midland	97,623	203,228
• Odessa	93,336	148,733
• San Angelo	88,774	158,972

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Chem. & Allied Products
- Petroleum Refining
- Food & Kindred

### Major Irrigated Crops

- Cotton
- Sorghum
- Wheat

Figure 3-32

## Historical and Projected Population and Water Use

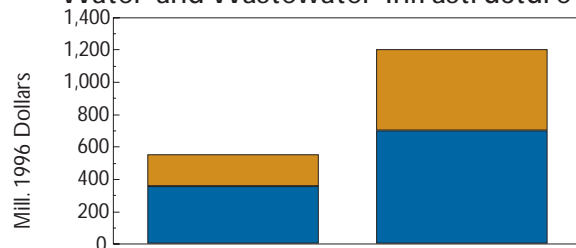
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	470,429	587,304	686,355	773,722	64.5%
% of State Total	2.77%	2.50%	2.24%	2.11%	-----
Municipal Water Use	96,120	126,217	137,230	153,037	59.2%
Industrial Water Use/1	35,701	41,285	37,923	38,560	8.0%
Agricultural Water Use/2	212,424	201,633	194,791	188,260	-11.4%
Irrigation Adjustment /3	0	(20,836)	(35,861)	(33,723)	-29.5%
Total Water Use	344,245	348,299	334,083	346,134	0.6%
% of State Total	2.18%	2.20%	2.26%	2.31%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
Midland	28,679	46,667
Odessa	21,424	27,157
San Angelo	24,693	34,368
Big Spring	7,089	6,230
Snyder	3,035	3,303

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$354.7	\$699.8
Wastewater	\$200.9	\$503.6
Total	\$555.6	\$1,203.4

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.15 Upper Colorado Region

**Regional Description.** The Upper Colorado Region is made up of 21 counties located in the Brazos, Colorado, and Rio Grande river basins. In 1980, the region's population totaled 431,674. By 1990, the region increased 9 percent to 470,429. This growth trend is expected to continue as the region is projected to increase about 65 percent to reach a population of nearly 774,000 by 2050.

In 1990, the Upper Colorado Region accounted for almost 3 percent of the State's total population and 2 percent of the State's total water use. Total water use in the region was about 344,300 acre-feet, with agriculture accounting for 62 percent of the region's water use. Agricultural water use is expected to decline about 30 percent over the projection period. This expected reduction in agricultural water use is due primarily to estimated insufficient quantities of ground-water supplies to meet current and projected irrigation water demands, combined with the anticipated use of more water-efficient irrigation technology. Municipal and industrial uses are projected to increase 59 percent and 8 percent, respectively, from 1990 to 2050.

Under the selected planning scenario, conservation in the municipal sector is projected to save more than 21,000 acre-feet by the year 2020 and 32,000 acre-feet by 2050 over scenarios without conservation. Irrigation and manufacturing conservation are projected to save 12,000 acre-feet by 2020 and 17,000 acre-feet by 2050 over scenarios with no conservation.

**Regional Water-related Problems and Needs.** The Colorado River Municipal Water District and the Ogallala (High Plains) Aquifer are the major sources of municipal and irrigation water, respectively. Historically, the withdrawal of groundwater has exceeded the natural recharge of the aquifer, resulting in declining water levels. Since the northern part of the region is focused on agriculture, irrigation supplies are of significant concern. Current projections show irrigation shortages in the region for the entire planning period of 2000-2050. Furthermore, steam-electric power generation water shortages are anticipated to begin in 2040. Although the region has already made significant advances toward surface water dependence, further development of surface water, along with an effective conservation program, will be required to ensure adequate irrigation supplies in the future.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**Colorado River Municipal Water District (CRMWD).** CRMWD was created by the Legislature of the State of Texas in 1949. Initially, the geographical boundaries of the CRMWD consisted of the city limits of the District's three cities, Odessa, Big Spring, and Snyder. An amendment in 1981 included a second jurisdictional boundary encompassing the drainage area of the Colorado River above the east county line of Coleman County. The boundary encompassed all or part of thirty-four counties. In addition, the counties of Ector, Ward, Winkler, Loving, Reeves, and Culberson were added by the amendment to the jurisdiction of the CRMWD. The CRMWD

owns and operates three reservoirs (Lakes J. B. Thomas, E.V. Spence and O.H. Ivie). The District also operates two ground- water well fields, one in Ward County and one in Martin County. Using present estimates of available supplies, the District should have adequate resources to meet the region's needs through 2050.

**Midland.** The City of Midland obtains its water from the Colorado River Municipal Water District (CRMWD) and the Paul Davis and McMillan well fields, which are owned by the City. The remaining water demands are met through contracts with the CRMWD and ownership of 16.5% of the O.H. Ivie Reservoir. The combination of the ground and surface water facilities are expected to fulfill the City's water needs through 2050.

**Odessa.** The City of Odessa receives both surface and ground water from the CRMWD. The current water supplies and an effective water conservation program will help the City meet its future water needs through 2050.

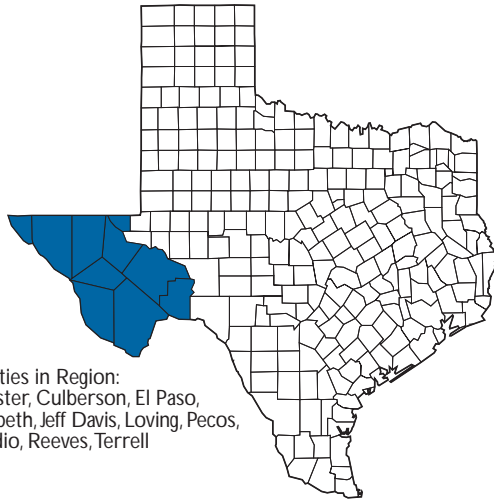
**San Angelo.** The City of San Angelo gets its water from Twin Buttes Reservoir and from the CRMWD. The City also has a well field in McCulloch County; however, the well field has not been developed due to conflicts with the Hickory UWCD over the transfer of water outside of the district. The City has also purchased approximately 16.5% of the O.H. Ivie Reservoir, which will add approximately 18,600 acre-feet of additional water to its supply. With the existing and proposed water supply sources and an effective water conservation plan, the City will be able to meet its water needs through 2050.

**Big Spring.** The City of Big Spring purchases all of its water from the CRMWD. The existing and proposed water supply sources, along with an effective water conservation program will ensure the City's needs are met through 2050.



# Upper Rio Grande Region

## Location Of Region



Counties in Region:  
Brewster, Culberson, El Paso,  
Hudspeth, Jeff Davis, Loving, Pecos,  
Presidio, Reeves, Terrell

## 1995 and 2050 Population Estimates and Projections for Major Centers

City	1995 Est./1	2050 Proj./2
• El Paso	577,911	1,234,889
• Socorro	27,830	80,341
• Fort Bliss	14,224	13,915
• Pecos	11,831	17,331

/1 State Data Center      /2 TWDB

### Major Water-Using Industries

- Petroleum Refining
- Apparel & Other Products
- Primary Metal Industries
- Food & Kindred

### Major Irrigated Crops

- Cotton
- Alfalfa
- Forage Crops

Figure 3-33

## Historical and Projected Population and Water Use

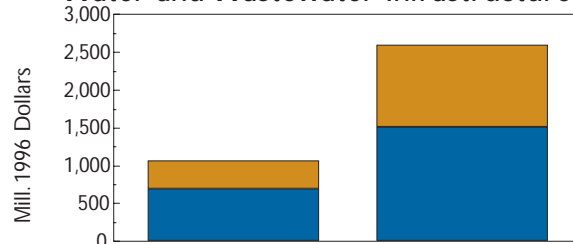
Category	1990	2010	2030	2050	% CHANGE 1990-2050
Population	647,240	994,931	1,341,385	1,628,430	151.6%
% of State Total	3.81%	4.24%	4.37%	4.44%	-----
Municipal Water Use	134,206	188,556	232,893	276,277	105.9%
Industrial Water Use/1	21,613	25,834	27,757	30,586	41.5%
Agricultural Water Use/2	501,935	451,617	436,555	417,944	-16.7%
Irrigation Adjustment /3	0	0	(86,409)	(94,667)	-36.3%
Total Water Use (ac-ft)	657,754	666,007	610,796	630,140	-4.20%
% of State Total	4.18%	4.21%	4.13%	4.22%	-----

/1 Includes manufacturing, steam electric power cooling, and mining water use. /2 Includes irrigation and livestock water use. /3 Irrigation water use adjustment reflects estimated levels of ground water availability.

## Municipal Water Use Projections for Selected Cities (in acre-feet)

City	2000	2050
El Paso	128,176	214,404
Alpine	1,451	2,326
Ft. Davis	236	225
Ft. Bliss	6,609	5,642
Pecos	3,030	3,397
Socorro	1,480	1,800

## Projected Capital Expenditures for Regional Water and Wastewater Infrastructure



	1996-2020	2021-2050
Water /1	\$696.7	\$1,509.6
Wastewater	\$374.9	\$1,087.9
<b>Total</b>	<b>\$1,071.6</b>	<b>\$2,597.5</b>

/1 Includes estimate of community owned water supply infrastructure, reservoirs, reallocation and modification, major conveyance, and chloride control.

### 3.2.16 Upper Rio Grande Region

**Regional Description.** The Upper Rio Grande Region is comprised of 10 counties in the Rio Grande River Basin. The region experienced a rapid population growth in the 1980's, increasing 22 percent from 532,455 in 1980 to 647,240 in 1990. This population growth trend is projected to continue making this region one of the State's fastest growing areas. From 1990 to 2050, the Upper Rio Grande Region is projected to increase about 152 percent, resulting in a 2050 population of approximately 1.6 million. In 1990, this region comprised 3.8 percent of the State's population. By 2050, it is projected to account for 4.5 percent.

In 1990, total water use in the region was about 658,000 acre-feet. With an anticipated increase in population growth, municipal water demand is projected to more than double from 134,206 acre-feet in 1990 to about 276,000 by 2050. Industrial water use is projected to increase by about 42%. Agricultural water use is the primary water use category in the region and is projected to decline by about 36 percent from 1990 to 2050. This decline in water requirements for irrigated agriculture is primarily the result of expected increases in more water-efficient irrigation technology and assumed voluntary transfers of water. Overall, the region is expected to experience a slight decline in total water use (4.2 percent) from 1990 to 2050.

Water savings due to conservation in the municipal sector are projected to total 46,000 acre-feet by 2020. These savings are anticipated to increase to 72,000 acre-feet by 2050. Conservation in irrigated agriculture, due to improved conveyance and irrigation systems, is projected to save 46,000 acre-feet by 2020 and 59,000 acre-feet by 2050 over planning scenarios with no conservation.

**Regional Water-related Problems and Needs.** At present, municipal use comprises 20 percent of all water used in the region (both groundwater and surface water) and irrigation use comprises 75 percent of water used. By year 2050, municipal use will comprise about 44 percent of all water used in the region and irrigation use will comprise about 50 percent. The municipal growth is expected to occur primarily in El Paso and areas immediately downstream. The Texas Natural Resource Conservation Commission's current effort to adjudicate water rights within the Upper Rio Grande Basin (the last area of the state remaining to be adjudicated) will help to prevent conflicts between the different uses and between individual water right holders in this area.

A matter of primary concern to the region is salinity of waters of the Pecos River. The Malaga Bend Salinity Control Project intends to improve the water quality of the Pecos River in Texas by reducing the natural discharge from a brine artesian aquifer located near Malaga, New Mexico. The project involves diverting saturated brine from the Rustler Aquifer, thus reducing the local head of the aquifer and minimizing intrusion into the Pecos River.

**Local Water-related Problems and Needs.** A brief narrative of the Board's evaluation of the water resources of the major cities and large water utility suppliers in the region is described below. Also included are other entities that could affect the water supply resources of the region. Data on other cities and supplies may be obtained from the Board's files.

**International United States- Mexico Treaty.** The treaty entered into by the United States and Mexico in 1944 clarifies each nation's share, establishes the methodology by which the shares are calculated and designates an international cooperative agency called the International Boundary Water Commission to calculate yearly allocations of international waters to the two nations. The treaty designates Fort Quitman as one of the dividing points between Mexico-United States international waters and El Paso as another important dividing point. The treaty specifies that Mexico can divert 60,000 acre-feet of water per year at El Paso, but is constrained from diverting water downstream of El Paso. The next water available to Mexico is IBWC's allocation to Mexico out of Amistad international reservoir based on a drainage area beginning at Fort Quitman rather than at El Paso.

**Rio Grande Compact.** This compact between the states of Colorado, New Mexico, and Texas was ratified by the Texas Legislature in 1939. The Compact obligates Colorado and New Mexico to deliver water in the Rio Grande at designated points so that Texas will receive Rio Grande waters downstream. The Compact establishes a streamgauge network and a very complicated accounting procedure by which each state's share is calculated yearly. The procedure varies with flow conditions, incorporating spills from and allowable storage in reservoirs of New Mexico and Colorado, accumulation of credits and debits, and adjustments for imports from other states. The Compact designates an interstate agency called the Rio Grande Compact Commission to implement yearly allocations between the signatory states.

**Pecos River Compact.** This Compact between the states of New Mexico and Texas addresses the beneficial consumptive use of water salvaged in New Mexico through the construction and operation of a project or projects by the United States or by joint undertakings of Texas and New Mexico, and the beneficial consumptive use of unappropriated water. Salvaged water is apportioned 43 percent to Texas and 57 percent to New Mexico, while unappropriated water (if any) is apportioned equally. Both salvaged water and unappropriated water are defined in terms of the conditions existing in 1947. New Mexico is not to deplete by man's activities the flow of the Pecos River at the New Mexico-Texas state line to levels below those existing in 1947. Each state has the right to replace reservoir capacity made unusable by any cause, to construct additional capacity for the utilization of water apportioned to the state by the Compact, and to construct works for the purpose of preventing flood damage. The Compact designates an interstate agency called the Pecos River Compact Commission to adopt rules and regulations, to establish gage stations, to engage in studies of water supplies of the Pecos River and its tributaries, to collect data and make findings pertaining to deliveries of water at the New Mexico-Texas state line or pertaining to reservoir losses or quantities of unappropriated flood waters.

**Watermaster Office of the Texas Natural Resource Conservation Commission (TNRCC).** The Watermaster Office of the state's regulatory agency (TNRCC) administers the allocation of Texas' share of international waters of the Rio Grande. Falcon and Amistad reservoirs, located in the middle and lower Rio Grande, store the water regulated by the Watermaster. The Watermaster oversees Texas' share of water in the Rio Grande and its Texas tributaries from Amistad dam to Fort Quitman, excluding drainage basins of the Pecos River and Devils River.

**Economically Distressed Areas Program (EDAP).** The Texas Water Development Board administers EDAP funds to qualifying municipalities and districts. The region has been the recipient of some \$18.7 million of EDAP funding in the form of loans and grants which are financing water and wastewater improvements in El Paso and Hudspeth counties. These improvements allow communities to tap into and effectively use the water supplies that are in the area and, in some instances, improve hygiene and health of the populace. Loan commitments include a water project for six colonias in the Socorro area, water and wastewater projects in the Westway area, water service to Homestead MUD, wastewater treatment in Sierra Blanca, and facility planning for future projects in the Canutillo, Tornillo and Vinton areas.

**El Paso.** The El Paso Public Service Board has benefited from EDAP funding for water and wastewater improvements, and also is pursuing DWSRF funding through the Safe Drinking Water Act. The City of El Paso's pipeline from the Rio Grande will allow it to expand its reliance on Rio Grande waters delivered by New Mexico per the Rio Grande Compact. The City will expand its current reuse of municipal wastewater and will also benefit from the New Mexico Channel Improvements project by about year 2030, and may utilize desalination technology to desalt groundwater for a portion of its future water supply.

**Alpine and Fort Davis.** These cities will continue to rely on groundwater occurring in igneous rocks of tertiary age throughout the 50-year planning horizon.

**Pecos.** The City of Pecos will continue to rely on groundwater of the Cenozoic Pecos Alluvium throughout the 50-year planning horizon.