

Section 1
Description of the
South Central Texas Region
[31 TAC §357.7(a)(1)]

1.1 Background

Water supplies of the South Central Texas Region are obtained from the Edwards-Balcones Fault Zone, Carrizo-Wilcox, Trinity, Edwards-Trinity (Plateau), and Gulf Coast Aquifers; from three minor aquifers (Queen City, Sparta, and Yegua-Jackson); and from the rivers, streams, and reservoirs within the region. The water supply picture of the region is very complex, involving intricate relationships between surface water and groundwater. The Edwards-Balcones Fault Zone Aquifer (hereinafter referred to as the Edwards Aquifer) supplied approximately 56 percent of the total water used in the South Central Texas Region in 2000. Water demands for the area that is now being supplied from the Edwards Aquifer are projected to grow at a rate of approximately 1.0 percent per year between 2000 and 2020. However, not even the present level of use can be sustained while maintaining levels of flows at Comal and San Marcos Springs adequate to support habitats of threatened and endangered species and also meet downstream water rights. Demands on the Trinity and Carrizo-Wilcox (hereinafter referred to as the Carrizo Aquifer) Aquifers of the South Central Texas Region exceed recharge in some areas. In other areas that now depend upon the Carrizo and Gulf Coast Aquifers, present withdrawal rates are substantially less than recharge. Throughout the region, there is an awareness of the dynamic interrelationships of surface water and groundwater and of the importance of maintaining instream flows and freshwater inflows to bays and estuaries.

Operations of the largest existing surface water supply sources in the region are also directly linked to the Edwards Aquifer. Dependable supplies from Canyon Reservoir for municipal and industrial customers are a function of springflows from the Edwards Aquifer, since inflow passage through Canyon Reservoir is necessary to meet downstream water rights when springflows drop below certain levels. Storage in the Medina Lake System contributes significantly to recharge of the Edwards Aquifer, and reservoirs used for steam-electric power generation (Coletto Creek, Calaveras, and Braunig) and hydropower generation are dependent upon springflows and/or treated municipal effluent that originate from the Edwards Aquifer. Surface water supplies available to the region are also a function of recharge to and withdrawal

from the aquifers, as are the quantities of streamflows permitted for use in counties of the Nueces, San Antonio, and Guadalupe River Basins outside of the South Central Texas Region. In water planning for the South Central Texas Region, these factors, together with the numerous potential water management strategies available to the South Central Texas Region, are taken into account herein.

1.2 Physical Description of the South Central Texas Region

The South Central Texas Region includes counties that are located in whole or in part in the Rio Grande, Nueces, San Antonio, Guadalupe, Colorado, and Lavaca River Basins, and the Colorado-Lavaca, Lavaca-Guadalupe, and San Antonio-Nueces Coastal Basins (Table 1-1). The physical terrain of the region ranges from the Hill Country of the Edwards Plateau to the Coastal Plains. A general description of the region, including geology, climate, water resources, vegetational areas, and major water demand centers, is presented in the following sections.

1.2.1 Climate¹

The South Central Texas Region lies in three climatic divisions of Texas: the Edwards Plateau, the South Central, and the Upper Coast. The climate of the region is classified as humid subtropical. Summers are usually hot and humid, while winters are often mild and dry. The hot weather is rather persistent from late May through September, accompanied by prevailing southeasterly winds. There is little change in the day-to-day summer weather, except for the occasional thunderstorm, which produces much of the annual precipitation within the region. The cool season, beginning about the first of November and extending through March, is also typically the driest season of the year. Winters are ordinarily short and mild, with most of the precipitation falling as drizzle or light rain. Any accumulation of snow is a rare occurrence. Polar air masses, which penetrate the region in winter, bring northerly winds and sharp drops in temperature for short periods of time.

In the coastal region, the climate is dominated by proximity to the Gulf of Mexico and characterized by prevailing southeasterly winds. During the long humid summers, high daytime temperatures, which are common in inland areas, are moderated in coastal areas by the Gulf breeze.

¹ Texas Water Development Board (TWDB) "Continuing Water Resources Planning and Development for Texas," May 1977.

**Table 1-1.
South Central Texas Region – List of Counties
Location by River Basin and Edwards Aquifer Area**

County	Edwards Aquifer Area ¹	Nueces Basin	San Antonio Basin	Guadalupe Basin	Lower Colorado Basin	Colorado-Lavaca Coastal Basin	Lavaca Basin	Lavaca-Guadalupe Coastal Basin	San Antonio-Nueces Coastal Basin	Rio Grande
Atascosa	X	X	X							
Bexar	X	X	X							
Caldwell	X			X	X					
Calhoun				X		X		X	X	
Comal	X		X	X						
DeWitt			X	X			X	X		
Dimmit		X								X
Frio		X								
Goliad			X	X					X	
Gonzales				X			X			
Guadalupe	X		X	X						
Hays (Part)	X			X						
Kames		X	X	X					X	
Kendall			X	X	X					
LaSalle		X								
Medina	X	X	X							
Refugio			X						X	
Uvalde	X	X								
Victoria			X	X			X	X		
Wilson		X	X	X						
Zavala		X								

An X in the column indicates that all or part of the county is located in the River or Coastal Basin named in the column heading.

¹ Edwards Aquifer Area is the area within the Edwards Aquifer Authority statutory boundaries.

Mean annual precipitation in the region ranges from a high of 38 inches per year in DeWitt County in the eastern part of the region, to a low of 23 inches per year in the Nueces River Basin in the west (Table 1-2). There is a general trend of decreasing precipitation from the eastern portions of the region to western portions. There is also a general trend of increasing precipitation from inland areas to coastal areas.

Table 1-2.
Climatological Data for the
South Central Texas Region

River Basin	Precipitation			Temperature					Annual Net Reservoir Surface Evaporation (inches)
	Mean Annual (inches)	Wettest Month(s)	Driest Month(s)	Mean Annual (°F)	Mean Daily Minimum		Mean Daily Maximum		
					January (°F)	July (°F)	January (°F)	July (°F)	
Rio Grande	25	Sept.	Mar.	74	48	74	71	96	65
Nueces	23	May, Sept.	Mar.	71	40	72	65	98	45
San Antonio	30	Sept.	Mar., Dec.	70	41	74	64	96	31
Guadalupe	32	May, Sept.	Mar.	79	37	71	60	95	37
Colorado	34	May, Sept.	Jan.	68	39	74	60	96	35
Lavaca	38	May, Sept.	Mar., July	70	41	72	65	98	24
Lavaca-Guadalupe	37	Sept.	Mar., July	70	44	76	64	94	25
San Antonio-Nueces	33	Sept.	Mar.	71	43	73	65	96	30
Colorado-Lavaca	41	Sept.	Mar., July	70	43	78	64	91	20

Source: Texas Water Development Board, "Continuing Water Resources Planning and Development for Texas," May 1977.

Although mean annual temperatures are basically uniform throughout the region, there are some marked seasonal variations, which lead to widely varied values for annual net reservoir surface evaporation. The values for annual net reservoir surface evaporation range from a high of 65 inches per year, for the portion of Dimmit County located in the Rio Grande River Basin, to a low of 24 inches per year, for the portion of DeWitt County that lies in the Lavaca River Basin (Table 1-2).

The South Central Texas Region is subject to the threat of hurricanes each year from mid-June through the end of October, and in those parts of the region along and near the coastline, the hazard of hurricane tides is prevalent. Although hurricane winds and tornadoes spawned by hurricanes cause extensive damage and occasional loss of life, surveys of hurricanes

reaching the Texas Coast indicate that storm tides cause by far the greatest destruction and largest number of deaths. Elsewhere, in the inland areas of the region, the greatest concern with regard to hurricanes is the damage that results from winds and flooding. Records dating back to 1871 show that, on average, a tropical storm or hurricane has affected the region once every 3 years.

1.2.2 General Geology²

The Hill Country area of the South Central Texas Region is underlain by Cretaceous Age limestone, which forms the Edwards Plateau. East and south of the Plateau are upper Cretaceous chalk, limestone, dolomite, and clay, with the extensive Balcones Fault Zone System marking the boundary between the Edwards Plateau and the Gulf Coastal Region. The entire sequence dips gently toward the southeast.

A Tertiary Age sequence of southeasterly dipping sand, silts, clay, glauconite, volcanic ash, and lignite overlie the Cretaceous Age strata. The primary water-bearing unit of this sequence is the Carrizo Aquifer. A sequence of clay, sand, caliche, and conglomerate of the Pliocene Age Goliad Formation underlie the coastal areas of the region.

Overlying the Goliad Formation is the Quaternary Age Lissie Formation, which consists of sand, silt, clay and minor amounts of gravel. Clay, silt, and fine-grained sand of the Beaumont Formation overlie the Lissie Formation. Throughout the region, alluvial sediments of Recent Age occur along streams and coastal areas.

1.2.3 Vegetational Areas³

Biologically, the South Central Texas Region is a region of transition from the lowland forests of the southeastern United States to the arid grasslands of the western uplands and tropical thorn scrub to the south. The essence of this landscape consists of dendritic networks of wooded stream corridors populated by typically eastern species that dissect upland grasslands, and savannahs that harbor western species. The vegetational areas containing portions of the South Central Texas Region are the Edwards Plateau, South Texas Plains, Blackland Prairies, Gulf Prairies and Marshes, and the Post Oak Savannah (Figure 1-1). Each area is described below.

² TWDB, Op. Cit., May 1977.

³ HDR Engineering, Inc. (HDR), et al., "Trans-Texas Water Program, West Central Study Area, Phase I Interim Report," Volume 2, San Antonio River Authority, et al., May 1994.

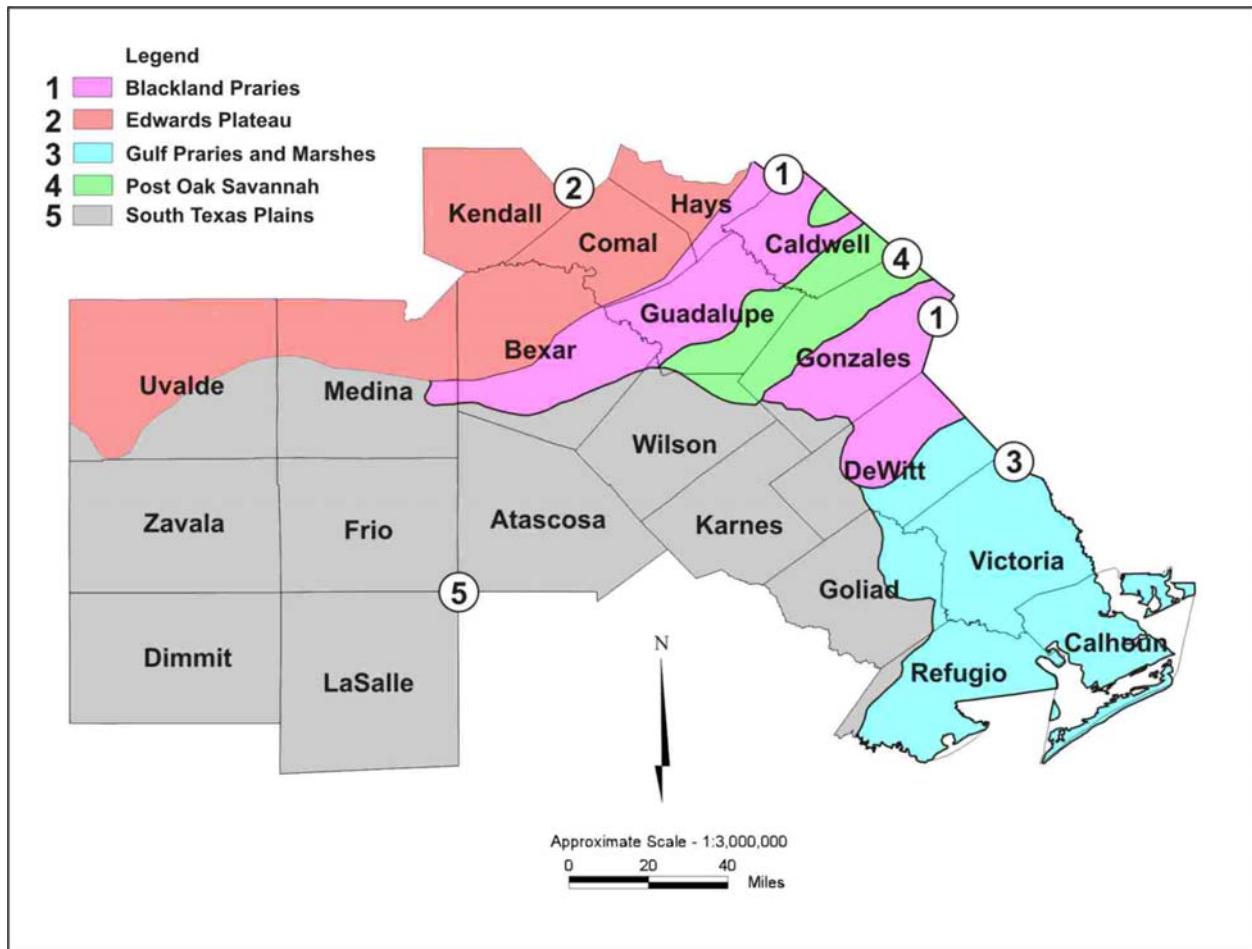


Figure 1-1. Eco-Regions — South Central Texas Region

1.2.3.1 Edwards Plateau

In the South Central Texas Region, the Edwards Plateau vegetational area includes all of Kendall County, the northern portions of Uvalde, Medina, Bexar, and Comal Counties, and the western portion of Hays County located within the planning area. This limestone-based area is characterized by springfed, perennially flowing streams that originate in its interior and flow across the Balcones Escarpment, which bounds it on the south and east. This area is also characterized by the occurrence of numerous ephemeral streams that are important conduits of storm runoff, which contributes to the recharge of the Edwards Aquifer. The soils are shallow, ranging from sands to clays, and are calcareous in reaction. This area is predominantly rangeland, with cultivation confined to limited areas having deeper soils.

Noteworthy is the growth of Bald cypress (*Taxodium distichum*) along the perennially flowing streams. Separated by many miles from cypress growth of the moist Southern Forest Belt, they constitute one of Texas' several "islands" of vegetation.

The principal grasses of the clay soils are several species of bluestem (*Schizachyrium* and *Andropogon* spp.), gramas (*Bouteloua* spp.), Indiangrass (*Sorghastrum nutans*), common curlymesquite (*Hilaria belangeri*), buffalograss (*Buchloe dactyloides*), and Canadian wild rye (*Elymus canadensis*). The rocky areas support tall or mid-grasses with an overstory of live oak (*Quercus virginiana*) and other oaks (*Q. fusiformis*, *Q. buckleyi*, *Q. sinuata* var. *breviloba*), cedar elm (*Ulmus crassifolia*) and mesquite (*Prosopis glandulosa*). The heavy clay soils have a mixture of buffalograss, sideoats grama (*Bouteloua curtipendula*), and mesquite.

1.2.3.2 South Texas Plains

South of San Antonio, including all or parts of Uvalde, Zavala, Dimmit, Medina, Frio, LaSalle, Bexar, Atascosa, Wilson, Karnes, DeWitt, Goliad, and Refugio Counties, lies the South Texas Plains vegetational area, which is characterized by subtropical dryland vegetation consisting of small trees, shrubs, cactus, weeds and grasses. Principal plants are honey mesquite (*Prosopis glandulosa* var. *torreyana*), live oak (*Quercus virginiana*), post oak (*Q. stellata*), several members of the cactus family (Cactaceae), blackbrush acacia (*Acacia rigidula*), guajillo (*Acacia berlandieri*), huisache (*Acacia farnesiana*) and others that often grow very densely. The original vegetation was mainly perennial warm-season bunchgrass in post oak, live oak, and mesquite savannahs. Other brush species form dense thickets on the ridges and along streams. Long-continued grazing, as well as the control of wildfires, has contributed to the dense cover of brush. Most of the desirable grasses have persisted under the protection of brush and cacti.

There are distinct differences in the original plant communities on various soils. Dominant grasses on the sandy loam soils are seacoast bluestem (*Schizachyrium scoparium* var. *littoralis*), bristlegrasses (*Setaria* spp.), and silver bluestem (*Bothriochloa saccharoides*). Dominant grasses on the clay and clay loams are silver bluestem, Arizona cottontop (*Trichachne californica*), buffalograss, common curlymesquite, bristlegrasses, gramas, and Texas wintergrass (*Stipa leucotricha*). Gulf cordgrass (*Spartina* spp.) and seashore saltgrass (*Distichlis spicata*) characterize low saline areas. In the post oak and live oak savannahs, the grasses are mainly seacoast bluestem, Indiangrass, and switchgrass (*Panicum virgatum*).

1.2.3.3 Blackland Prairies

This area, including parts of Bexar, Comal, Guadalupe, Hays, Caldwell, Gonzales, and DeWitt Counties, while called a “prairie,” has timber along the streams, including a variety of oaks, pecan (*Carya illinoensis*), cedar elm and mesquite. In its native state, it was largely a grassy plain.

Most of this fertile area has been cultivated, and only small acreages of meadowland remain in original vegetation. In heavily grazed pastures, buffalograss, Texas grama (*Bouteloua rigidiseta*) and other less-productive grasses have replaced the tall bunchgrass. Mesquite and other woody plants have invaded the grasslands.

The original grass vegetation included big bluestem (*Andropogon gerardii*) and little bluestem (*Schizachyrium scoparium* var. *frequens*), Indiangrass, switchgrass, sideoats grama, hairy grama (*Bouteloua hirsuta*), tall dropseed (*Sporobolus asper*), Texas wintergrass and buffalograss. Non-grass vegetation is largely legumes and composites.

1.2.3.4 Gulf Prairies and Marshes

The Gulf Prairies and Marshes vegetational area includes all or parts of Victoria, DeWitt, Goliad, Refugio, and Calhoun Counties. There are two subunits: (1) the marsh and salt grasses immediately at tidewater; and (2) a little farther inland, a strip of bluestems and tall grasses, with some grammas in the western part. Many of these grasses make excellent grazing. Oaks, elm, and other hardwoods grow to some extent, especially along streams, and the area has some post oak and brushy extensions along its borders. Much of the Gulf Prairies is fertile farmland.

Principal grasses of the Gulf Prairies are tall bunchgrasses, including big bluestem, little bluestem, seacoast bluestem, Indiangrass, eastern gamagrass (*Tripsacum dactyloides*), Texas wintergrass, switchgrass, and gulf cordgrass. Seashore saltgrass occurs on most saline sites. Heavy grazing has changed the range vegetation in many cases so that the predominant grasses are less desirable broomsedge (*Andropogon virginicus*), smutgrass (*Sporobolus indicus*), threeawns (*Aristida* spp.) and many other inferior grasses. The other plants that have invaded the productive grasslands include oak underbrush, huisache, mesquite, pricklypear (*Opuntia* spp.), ragweed (*Ambrosia psilostachya*), broomweed (*Xanthocephalum* spp.), and others.

1.2.3.5 Post Oak Savannah

This secondary forest region, also called the Post Oak Belt, includes parts of Guadalupe, Caldwell, Wilson, and Gonzales Counties. It is immediately west of the primary forest region, with less annual rainfall and a little higher elevation. Principal trees are post oak, blackjack oak (*Quercus marilandica*) and cedar elm. Pecans, walnuts (*Juglans* spp.) and other kinds of water-demanding trees grow along streams. The southwestern extension of this belt is often poorly defined, with large areas of prairie.

The original vegetation consisted mainly of little bluestem, big bluestem, Indiangrass, switchgrass, silver bluestem, Texas wintergrass, post oak and blackjack oak. The area is still largely native or improved grasslands, with farms located throughout. Intensive grazing has contributed to dense stands of a woody understory of yaupon (*Ilex vomitoria*) and oak brush, and mesquite has become a serious problem. In addition, the control of wildfires has affected the encroachment of brush species on Savannah range lands. Such plants as broomsedge, broomweed, and ragweed have replaced good forage plants.

1.2.4 Natural Resources

1.2.4.1 Water Resources

The South Central Texas Region includes parts of six major river basins (Rio Grande, Nueces, San Antonio, Guadalupe, Lavaca, and Lower Colorado) and overlies the Edwards and Gulf Coast Aquifers, and southern parts of the Trinity, Carrizo, and Edwards-Trinity (Plateau) Aquifers. In addition to these water resources, the area also overlies three minor aquifers (Queen City, Sparta, and Yegua-Jackson). Details about these water resources are presented in Sections 1.7 and 3.

Springs also serve as a significant water resource in the South Central Texas Region. The two most noteworthy springs are the Comal and San Marcos Springs, which both contribute to flow in the Guadalupe River. The San Marcos Springs have the greatest flow dependability and environmental stability of any spring system in the southwestern United States. Constancy of its springflow is apparently key to the unique ecosystem found in the uppermost San Marcos River. Comal Springs, located in New Braunfels, serve as the source for the Comal River, which is a tributary of the Guadalupe River. Unlike the San Marcos Springs, Comal Springs is more responsive to drought conditions and ceased flowing in June of 1956 in response to severe drought conditions. In addition, numerous springs in northern Uvalde and Medina Counties

provide surface flows that recharge the Edwards Aquifer and a few springs, such as Leona Springs and Soldier Springs at Uvalde, flow from below the Edwards Aquifer recharge zone providing surface flows for many miles downstream.

1.2.4.2 Fish and Wildlife Resources

The streams and reservoirs of the South Central Texas Region encompass habitats that range from the clear, rocky headwaters of the Guadalupe and Nueces Rivers on the Edwards Plateau to the sluggish, turbid river reaches of the coastal plains, all supporting fish communities typical of warm, carbonate dominated hard waters. These include gar, minnows, topminnows, sunfishes and bass, catfish, and a few species of darters and suckers. Although strongly dependant on the physical habitat factors present, typical species include the common carp, red shiner, blacktail shiner, topminnow, longear and bluegill sunfish, largemouth and Guadalupe bass, channel catfish, bullheads, dusky darter, bigscale logperch, and grey redhorse. The Guadalupe Estuary, at the mouth of the Guadalupe River, is habitat to brown and white shrimp, blue crabs, eastern oysters, red drum, spotted seatrout, black drum, flounder, mullet, Atlantic croaker, sharks, and kingfish.

Common types of wildlife found in the area include white-tailed deer, raccoons, ringtails, gray foxes, coyotes, bobcats, and several species of skunks. Wintering songbirds such as robins and cedar waxwings may also be found. In addition, a growing population of endangered whooping cranes winters in and near the Aransas National Wildlife Refuge which is located on Blackjack Peninsula and Matagorda Island adjacent to San Antonio Bay.

A key concern in the South Central Texas Region is that of threatened and endangered species. There are a number of species listed in the planning region by the U.S. Fish and Wildlife Service or the Texas Parks and Wildlife Department as threatened or endangered. These species are listed by county in Appendix H with notations concerning their habitat preferences and protected status, if any.

1.2.4.3 Agricultural Resources

Of the 12.8 million acres of land area in the planning region, over 10.67 million acres (83 percent) are classified as farmland and ranchland (Table 1-3). In 2007, there were 25,981 farms and ranches in the region with an average size of 695 acres. Of the 10.67 million acres of

**Table 1-3.
Agricultural Resources — 2007
South Central Texas Region**

County	Total Land Area (acres)	Farms and Ranches (number)	Land in Farms and Ranches (acres)	Average Size (acres)	Total Cropland (acres)	Harvested Cropland (acres)	Irrigated Land (acres)
Atascosa	788,480	1,810	643,594	356	139,080	52,418	22,644
Bexar	798,080	2,496	425,909	171	124,952	59,827	14,091
Caldwell	349,440	1,421	304,737	214	71,459	43,862	909
Calhoun	327,680	291	230,400	792	88,885	61,537	3,569
Comal	359,680	939	192,454	205	37,467	13,468	517
De Witt	581,760	1,811	549,237	303	78,581	42,802	1,213
Dimmit	851,840	388	708,015	1,825	29,108	5,630	5,519
Frio	725,120	724	645,429	891	151,274	57,479	42,895
Goliad	546,560	1,083	469,513	434	58,898	31,576	903
Gonzales	683,520	1,861	654,077	351	99,016	50,836	5,275
Guadalupe	455,040	2,462	385,015	156	125,959	83,517	1,094
Hays (part) ¹	239,360	568	117,784	207	19,633	7,779	471
Karnes	480,000	1,208	417,484	346	104,454	57,740	1,390
Kendall	424,320	1,164	342,515	294	34,071	10,069	694
LaSalle	952,960	399	649,126	1,627	76,270	12,859	8,822
Medina	849,920	2,139	748,144	350	173,541	95,022	41,210
Refugio	492,800	295	490,565	1,663	94,329	75,615	(D)
Uvalde	996,480	690	989,917	1,435	131,420	66,273	45,344
Victoria	565,120	1,351	493,823	366	134,085	79,299	2,844
Wilson	516,480	2,570	467,187	182	153,867	73,012	13,462
Zavala	831,360	311	752,017	2,418	101,534	36,032	26,117
Total	12,816,000	25,981	10,676,942	695	2,031,883	1,016,652	238,983+(D)

¹ Estimate for that portion of Hays County located in the planning region.

(D) – Withheld to avoid disclosing data for individual producers.

Source: 2007 Census of Agriculture, Vol. 1 Geographic Area Series, "Table 1: County Summary Highlights — 2007."

farmland, over 2.03 million acres were classified as cropland, of which about 1.02 million acres were harvested in 2007. Approximately 12 percent (238,983 acres) of the total cropland in the region was reported to be irrigated in 2007.⁴ The leading irrigation counties are located in the western part of the region and include Uvalde, Frio, Medina, Atascosa, and Zavala. The sum of irrigated acres in these five counties decreased by 7.1 percent between 2002 and 2007. In Uvalde and Medina Counties, which rely primarily on the Edwards Aquifer, irrigated acres decreased by 17.1 and 25.8 percent respectively, between 2002 and 2007. Major irrigated crops are corn, cotton, grain sorghum, wheat, rice, soybeans, and vegetables. Cow-calf operations are the predominant type of livestock industry, although beef cattle, hogs and pigs, sheep and lambs, and poultry are also produced. (Agricultural production and livestock production are discussed in greater detail in Sections 1.4.2 and 1.4.3, respectively.)

1.2.5 Major Water Demand Centers

In the South Central Texas Region, there are four major water demand centers. These centers are the Interstate Highway 35 (IH-35) corridor from San Antonio to San Marcos, the Edwards Aquifer region west of the City of San Antonio, the Winter Garden area south of the Edwards Aquifer area, and the Coastal area. The San Antonio, New Braunfels, and San Marcos corridor along IH-35 is one of the fastest growing areas in Texas. In the next 60 years, its water use will follow the same trend as population growth, with most of the demand being for municipal use.

The Edwards Aquifer region west of San Antonio, including Uvalde and Medina Counties, is a major demand center for water to be used for irrigated agriculture. The Winter Garden area, including Zavala, Dimmit, Frio, LaSalle, and Atascosa Counties, is also a major demand center for water for irrigated agriculture. The Coastal area, including the cities of Victoria and Port Lavaca, are major demand centers for water for industrial purposes, with some demand for irrigation in Calhoun County.

1.3 Population and Demography

1.3.1 Historical and Recent Trends in Population

According to the Bureau of the Census, the South Central Texas Region population has increased from 806,770 in 1950 to 2,042,221 in 2000, an increase of 1,235,451 or 2.5 times

⁴ 2007 Census of Agriculture, Volume 1 Geographic Area Series, "Table 1. County Summary Highlights: 2007."

(Table 1-4). The largest percentage increase occurred between the years 1950 and 1960 (25.8 percent), while the smallest occurred between 1960 and 1970 (16.2 percent). During the period 1950 to 2000, 15 counties had a positive annual growth rate, while six counties (DeWitt, Dimmit, Gonzales, Karnes, LaSalle, and Refugio) had a negative annual growth rate. Historically, the fastest growing counties in the region were Hays (3.30 percent), Comal (3.17 percent), Kendall (3.00 percent), and Guadalupe (2.54 percent), while the slowest growing counties were Zavala (0.07 percent), Goliad (0.22 percent), Frio (0.91 percent), and Uvalde (0.97 percent). Section 2.1 summarizes population projections through the year 2060 for the South Central Texas Region.

There are 111 cities or other water supply entities in the South Central Texas Region for which the TWDB has made population and water demand projections. Of the 111 cities and entities, 44 have a population greater than 5,000. These entities are relatively equally distributed among the 21 counties in the planning region and are located in three commonly used regional references (Coastal, Hill Country, and Winter Garden) (Table 1-5). Bexar County contains 14 entities having a population of 5,000 or more, including San Antonio and its surrounding suburbs. Four counties, Goliad, Karnes, La Salle, and Refugio, do not have an entity of 5,000 or greater in population.

1.3.2 Demographic Characteristics

In 2000, 81 percent of the South Central Texas Region population resided in urban areas, while only 19 percent resided in rural areas (Figure 1-2). LaSalle County had the lowest population in 2000, with 5,866 residents (averaging 3.9 persons per square mile), while Bexar County had the highest population in the region with 1,392,931 residents (averaging 1,117 persons per square mile) (Table 1-6).

Age distribution across the region is characterized by a relatively young population. The two age groups that include the highest percentage of the population are under 18 years of age (28.2 percent) and from 34 to 44 years of age (14.9 percent) (Figure 1-3). The age groups with the lowest percentage of the population are ages 55 to 64 (8.7 percent) and ages 18 to 24 (9.3 percent) (Figure 1-3).

Table 1-4.
Population Growth — 1950 to 2000
South Central Texas Region

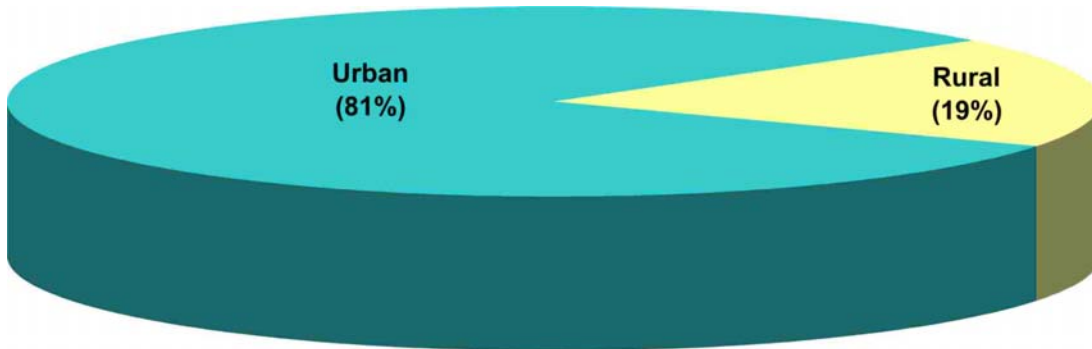
County	Year						Growth Rate ¹ (%)
	1950	1960	1970	1980	1990	2000	
Atascosa	20,048	18,828	18,696	25,055	30,533	38,628	1.32
Bexar	500,460	687,151	830,460	988,800	1,185,394	1,392,931	2.07
Caldwell	19,350	17,222	21,178	23,637	26,392	32,194	1.02
Calhoun	9,222	16,592	17,831	19,574	19,053	20,647	1.63
Comal	16,357	19,844	24,165	36,446	51,832	78,021	3.17
DeWitt	22,973	20,683	18,660	18,903	18,840	20,013	-0.28
Dimmit	10,654	10,095	9,039	11,367	10,433	10,248	-0.08
Frio	10,357	10,112	11,159	13,785	13,472	16,252	0.91
Goliad	6,219	5,429	4,869	5,193	5,980	6,928	0.22
Gonzales	21,164	17,845	16,375	16,883	17,205	18,628	-0.25
Guadalupe	25,392	29,017	33,554	46,708	64,873	89,023	2.54
Hays (part) ²	14,272	15,947	22,114	32,475	52,491	72,499	3.30
Karnes	17,139	14,995	13,462	13,593	12,455	15,446	-0.21
Kendall	5,423	5,889	6,964	10,635	14,589	23,743	3.00
LaSalle	7,485	5,972	5,014	5,514	5,254	5,866	-0.49
Medina	17,013	18,904	20,249	23,164	27,312	39,304	1.69
Refugio	10,113	10,975	9,494	9,289	7,976	7,828	-0.51
Uvalde	16,015	16,814	17,348	22,441	23,340	25,926	0.97
Victoria	31,241	46,475	53,766	68,807	74,361	84,088	2.00
Wilson	14,672	13,267	13,041	16,756	22,650	32,408	1.60
Zavala	11,201	12,696	11,370	11,666	12,162	11,600	0.07
Total	806,770	1,014,752	1,178,808	1,420,691	1,696,597	2,042,221	1.87

¹ Compound annual growth rate.
² Estimate that 80 percent of the total county population resides within the planning area.
Source: Bureau of the Census, Decadal Censuses of 1950, 1960, 1970, 1980, 1990, and 2000, U.S. Department of Commerce.

**Table 1-5.
Major Entities in the
South Central Texas Region***

City Name	County Name	Regional Classification	City Name	County Name	Regional Classification
Alamo Heights	Bexar	Hill Country	Leon Valley	Bexar	Hill Country
Atascosa Rural WSC	Bexar	Hill Country	Live Oak	Bexar	Hill Country
Benton City WSC	Atascosa	Winter Garden	Lockhart	Caldwell	Hill Country
Bexar Met Water District	Bexar	Hill Country	Luling	Caldwell	Hill Country
Boerne	Kendall	Hill Country	McCoy WSC	Atascosa	Winter Garden
Canyon Lake WSC	Comal	Hill Country	New Braunfels	Comal	Hill Country
Carrizo Springs	Dimmit	Winter Garden	Pearsall	Frio	Winter Garden
Converse	Bexar	Hill Country	Pleasanton	Atascosa	Winter Garden
Crystal City	Zavala	Winter Garden	Port Lavaca	Calhoun	Coastal
Crystal Clear WSC	Guadalupe	Hill Country	San Antonio	Bexar	Hill Country
Cuero	DeWitt	Coastal	San Marcos	Hays	Hill Country
East Central WSC	Bexar	Hill Country	Schertz	Guadalupe	Hill Country
East Medina SUD	Medina	Hill Country	Seguin	Guadalupe	Hill Country
Floresville	Wilson	Winter Garden	Springs Hill WSC	Guadalupe	Hill Country
Goforth WSC	Hays	Hill Country	SS WSC	Wilson	Winter Garden
Gonzales	Gonzales	Coastal	Terrell Hills	Bexar	Hill Country
Gonzales County WSC	Gonzales	Coastal	Universal City	Bexar	Hill Country
Green Valley SUD	Guadalupe	Hill Country	Uvalde	Uvalde	Winter Garden
Hondo	Medina	Hill Country	Victoria	Victoria	Coastal
Kirby	Bexar	Hill Country	Water Services Inc.	Bexar	Hill Country
Kyle	Hays	Hill Country	Wimberley WSC	Hays	Hill Country
Lackland AFB	Bexar	Hill Country	Windcrest	Bexar	Hill Country

* Entities with population of 5,000 or more in 2000.



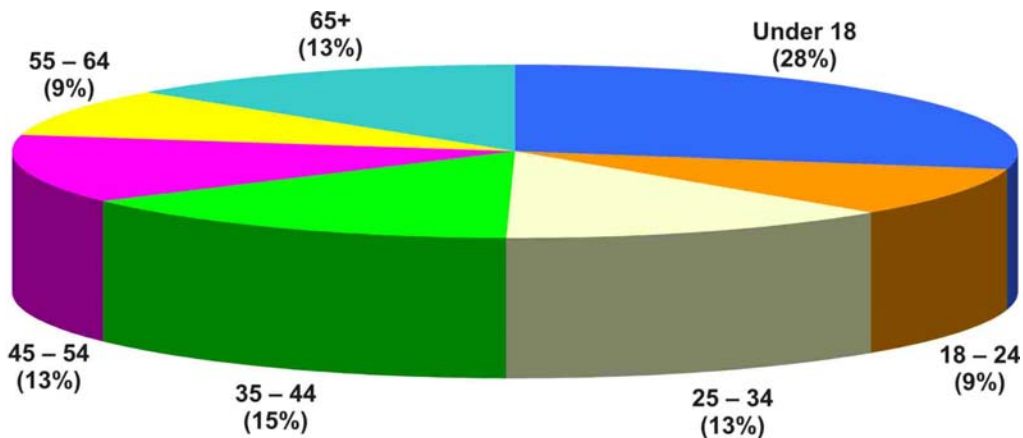
Source: U.S. Bureau; 2000 U.S. Census Data C90STF3A

**Figure 1-2. Percentages of Population Residing in Urban and Rural Areas (2000)
South Central Texas Region**

**Table 1-6.
County Population and Area
South Central Texas Region**

County	Population (2000)	Area (sq. mi.)	County	Population (2000)	Area (sq. mi.)
Atascosa	38,628	1,232	Hays (part)	72,499	374
Bexar	1,392,931	1,247	Karnes	15,446	750
Caldwell	32,194	546	Kendall	23,743	663
Calhoun	20,647	512	LaSalle	5,866	1,489
Comal	78,021	562	Medina	39,304	1,328
DeWitt	20,013	909	Refugio	7,828	770
Dimmit	10,248	1,331	Uvalde	25,926	1,557
Frio	16,252	1,133	Victoria	84,088	883
Goliad	6,928	854	Wilson	32,408	807
Gonzales	18,628	1,068	Zavala	11,600	1,299
Guadalupe	89,023	711	Total	2,042,221	20,025

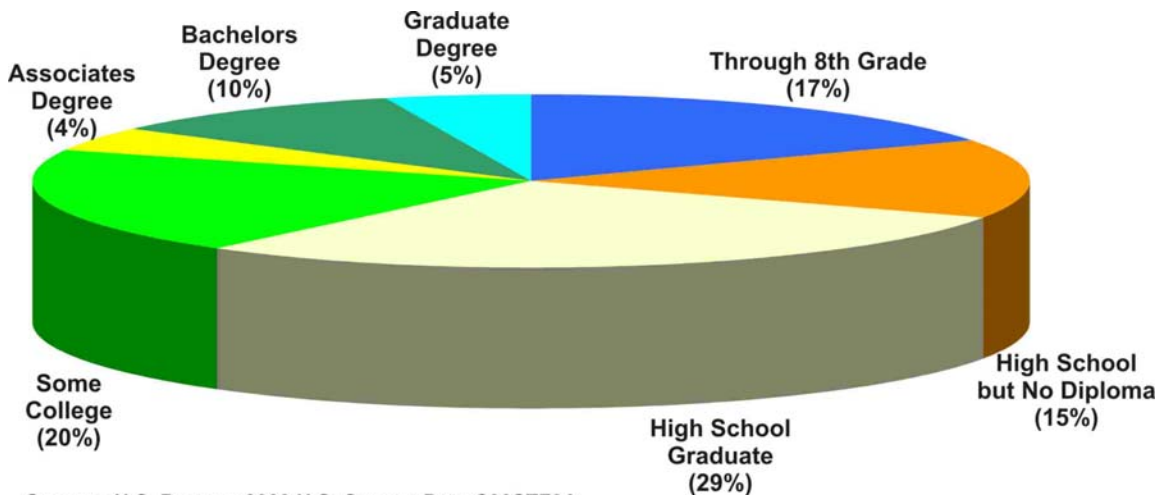
Source: U.S. Census Bureau, U.S. Department of Commerce.



Source: U.S. Bureau; 2000 U.S. Census Data C90STF3A

**Figure 1-3. Age Distribution of the Population (2000)
South Central Texas Region**

The regional population can also be characterized by its level of education. Of those residents in the South Central Texas Region who are 25 years of age or older, 68.2 percent have at least a high school diploma, while 31.8 percent do not. The two largest groups rated according to educational achievement are those who have completed high school, but have not gone on to college (29.0 percent) and those who have completed some college education, but have no degree (20.0 percent). Only 4.7 percent of the population who are 25 years or older have a graduate degree (Figure 1-4).



Source: U.S. Bureau; 2000 U.S. Census Data C90STF3A

**Figure 1-4. Level of Educational Achievement (2000)
South Central Texas Region**

1.4 Economy — Major Sectors and Industries

1.4.1 Summary of the South Central Texas Regional Economy⁵

The South Central Texas Region has an economic base centered on agricultural production, livestock production, mining, manufacturing, and trades and services. The region has experienced economic ups and downs throughout the past decade, but all sectors of the economy, with the exception of the mining sector, have experienced solid growth in recent years. Paralleling economic growth, employment in the diversified regional economy is supported by a strong trades and services sector, which accounts for approximately 76 percent of the value of output and a thriving tourism industry in San Antonio. Fabricated metal products, industrial machinery, petrochemicals, and food processing form the core of the manufacturing sector, which accounts for approximately 21 percent of the value of output in the South Central Texas Region. Beef cattle, corn, and grain sorghum are the dominant agricultural enterprises, although vegetables produced in the Winter Garden area add diversity to the agricultural sector. More detailed summaries of the agricultural, livestock, mining, manufacturing, and trades and services sectors are presented in the following sections.

1.4.2 Agricultural Production

It is estimated that over 2.7 million acres in the South Central Texas Region were used in crop production in 2007. Of this total, only 238,983 acres (8.7 percent) were irrigated while the remaining 91.3 percent of the total cropland was farmed using dryland techniques. The leading irrigation counties are found primarily in the western part of the region and include Uvalde, Frio, Medina, Atascosa, and Zavala.

According to the 2007 Census of Agriculture, all crops grown in the South Central Texas Region had a market value of over \$373 million in 2007. The leading agricultural producing counties in the region, by market value of products, are Bexar, Medina, Frio, Uvalde, and Victoria. The major crops grown in the region include corn, grain sorghum, wheat, soybeans and cotton (Table 1-7).

⁵ Information summarized from reports by the Texas Comptroller's Office.

**Table 1-7.
Summary of Farm Production Data 2007
South Central Texas Region**

County	Cropland			Market Value of all Crops (\$1,000)	Selected Crops Harvested						
	Total Cropland (acres)	Irrigated Land (acres)	Non-Irrigated Land (acres)		Corn (bushels)	Grain Sorghum (bushels)	Wheat (bushels)	Rice (100 lbs)	Cotton (bales)	Soybeans (bushels)	Hay, Alfalfa, Other (tons)
Atascosa	139,080	22,644	116,436	16,569	167,289	100,757	11,250	0	5,342	(D)	96,226
Bexar	124,952	14,091	110,861	64,471	667,681	322,503	163,134	0	4,655	21,220	96,455
Caldwell	71,459	909	70,550	7,463	482,631	300,172	(D)	0	6,114	0	69,987
Calhoun	88,885	3,569	85,316	20,061	2,859,126	801,557	0	179,313	23,008	(D)	6,653
Comal	37,467	517	36,950	2,920	162,004	103,602	34,097	0	0	0	22,161
DeWitt	78,581	1,213	77,368	6,657	620,914	(D)	6,479	0	569	0	93,751
Dimmit	29,108	5,519	23,589	2,617	(D)	32,822	(D)	0	(D)	(D)	4,857
Frio	151,274	42,895	108,379	39,640	452,648	544,033	206,960	0	6,355	0	33,061
Goliad	58,898	903	57,995	4,707	614,410	120,832	(D)	0	3,576	(D)	53,487
Gonzales	99,016	5,275	93,741	15,281	552,774	29,770	(D)	0	0	0	140,070
Guadalupe	125,959	1,094	124,865	18,807	1,422,369	736,145	266,105	0	1,403	0	101,164
Hays (part) ¹	19,633	471	19,162	2,394	53,603	(D)	27,058	0	(D)	0	25,617
Karnes	104,454	1,390	103,064	10,638	1,343,055	244,614	44,276	0	(D)	0	82,729
Kendall	34,071	694	33,377	981	4,700	0	2,750	0	0	0	21,800
LaSalle	76,270	8,822	67,448	7,779	(D)	(D)	38,489	0	0	0	9,017
Medina	173,541	41,210	132,331	43,287	2,770,486	1,160,786	255,277	0	19,220	0	82,326
Refugio	94,329	(D)	(D)	20,039	488,000	2,062,653	(D)	0	40,500	0	8,783
Uvalde	131,420	45,344	86,076	31,783	1,956,506	1,352,904	208,482	0	17,093	0	27,040
Victoria	134,085	2,844	131,241	23,491	4,243,626	544,032	(D)	(D)	7,652	148,791	51,559
Willson	153,867	13,462	140,405	15,566	960,096	440,412	43,099	0	3,256	0	132,380
Zavala	101,534	26,117	75,417	18,443	230,138	654,839	185,939	0	8,647	0	10,257
Total	2,738,015	238,983+(D)	2,499,032+(D)	373,594	20,052,056+(D)	9,552,433+(D)	1,493,395+(D)	179,313+(D)	147,390+(D)	170,011+(D)	1,169,380

¹ Estimate for that portion of Hays County located in the planning region.
(D) – Withheld to avoid disclosing data for individual producers.

Source: 2007 Census of Agriculture, Volume 1 Geographic Area Series, "Table 1. County Summary Highlights: 2007."

Corn and grain sorghum have historically been the leading crops in the region. In 2007, it was estimated that over 20 million bushels of corn were harvested in the South Central Texas Region, having a market value of \$64.8 million. The leading corn producing counties in the region are Victoria, Medina, Calhoun, and Uvalde (Table 1-7).

Grain sorghum also contributes significantly to the agricultural sector. In 2007, it was estimated that over 9 million bushels of grain sorghum were harvested in the region, having a market value of \$29.5 million. The leading grain sorghum producing counties in the region are Refugio, Uvalde, Medina, and Calhoun (Table 1-7).

Although wheat production is not as widespread as corn and grain sorghum production, it is still an important part of the regional agricultural production with over 1 million bushels of wheat harvested in 2007, with a market value of close to \$8.0 million. The leading wheat producing counties in the region are Guadalupe, Medina, Uvalde, and Frio (Table 1-7).

Because of favorable climatic and soil conditions, the coastal counties of Calhoun and Victoria are able to produce rice. In 2007, these two counties combined produced over 179,000 hundredweight (cwt) of rice which had a market value of over \$1.7 million (Table 1-7).

Cotton production is widespread throughout the region. In 2007, the 17 counties in which cotton is produced combined to harvest over 147,000 bales with a market value of over \$34 million (Table 1-7).

The majority of soybean production in the region occurs in the area extending from the Gulf Coast to DeWitt and Karnes Counties. The two leading soybean producing counties are Victoria and Bexar, while all counties engaged in soybean production combined to harvest over 170,000 bushels of soybeans with a market value of approximately \$1.3 million in 2007 (Table 1-7).

1.4.3 Livestock Production

According to the 2007 Census of Agriculture, livestock marketed in the South Central Texas region had a market value of over \$854 million, or about 2.3 times the value of crop production. Major types of livestock produced in the area include cattle and calves, beef cattle, and sheep and lambs. Layers, pullets, and broilers also contribute significantly to livestock production, with Gonzales County producing over 99 percent of these types of livestock within the region. In 2007, the leading livestock producing counties in the region by market value were Gonzales, Uvalde, Zavala, and Caldwell Counties (Table 1-8).

Table 1-8.
Summary of Livestock Production Data — 2007
South Central Texas Region

County	Market Value of Livestock (\$1,000)	Livestock and Poultry						
		Cattle & Calves (Number)	Beef Cows (Number)	Milk Cows (Number)	Hogs & Pigs (Number)	Sheep & Lambs (Number)	Layers & Pullets (Number)	Broilers (Number)
Atascosa	33,684	94,226	(D)	(D)	208	1,049	1,584	(D)
Bexar	19,751	35,820	(D)	(D)	1,241	3,403	11,118	1,252
Caldwell	39,570	45,291	28,401	0	93	516	(D)	1,128,540
Calhoun	8,901	19,057	13,174	0	10	254	453	0
Comal	3,636	12,868	7,988	0	137	3,512	2,946	0
DeWitt	34,326	108,324	(D)	(D)	491	356	61,229	(D)
Dimmit	19,074	29,045	11,398	0	30	184	269	0
Frio	30,637	51,411	21,386	0	133	98	311	0
Goliad	15,304	58,236	38,686	46	62	108	884	0
Gonzales	388,738	160,799	74,967	15	606	889	4,909,610	75,471,968
Guadalupe	22,371	52,045	(D)	(D)	1,118	2,676	140,828	(D)
Hays (part) ¹	3,333	8,155	4,970	2	128	785	15,568	28
Karnes	13,925	59,840	(D)	(D)	81	411	572	0
Kendall	6,651	15,485	9,311	25	442	9,491	1,819	(D)
LaSalle	23,271	33,550	15,277	0	27	125	(D)	0
Medina	37,562	55,759	(D)	(D)	360	2,981	2,488	(D)
Refugio	9,338	33,197	23,318	0	47	(D)	154	0
Uvalde	45,903	52,366	17,961	0	120	10,050	846	(D)
Victoria	19,933	59,059	39,441	22	149	303	878	0
Wilson	37,350	96,310	(D)	(D)	714	1,308	3,645	302
Zavala	41,327	66,641	(D)	(D)	(D)	70	162	0
Total	854,585	1,147,484	306,278+(D)	110+(D)	6,197+(D)	38,569+(D)	5,155,434+(D)	76,602,090+(D)

¹ Estimates that 50 percent of all livestock production in Hays County occurs in the planning region.
(D) – Withheld to avoid disclosing data for individual producers.
Source: 2007 Census of Agriculture, Volume 1 Geographic Area Series, "Table 1. County Summary Highlights: 2007."

1.4.4 Mining

The South Central Texas Region contains many sand and gravel quarries and is also rich in petroleum products including oil, natural gas, and lignite. Much of the stone quarried is used in the production of cement. The leading cement producing areas in the region are located in Bexar and Hays Counties. Most of the stone, gravel, and sand mining activities are located in Bexar, Comal, Gonzales, and Victoria Counties.

The region also derives a significant portion of its mining income from oil and gas activities. All but three counties (Comal, Hays, and Kendall) derived some of their revenues from oil and gas production in 2002. Oil and gas production in the remaining 18 counties generated over \$290 million in 2002 and provided approximately 3,500 jobs in the region. The leading oil and gas producing counties in the region are Refugio, Goliad, Victoria, DeWitt, and La Salle.

1.4.5 Manufacturing⁶

In 2002, manufacturing facilities contributed over \$13 billion in sales and provided 56,448 jobs in the South Central Texas Region (Table 1-9).⁷ The leading manufacturing counties, by value of shipments, in the region are Bexar, Calhoun, Guadalupe, and Victoria. The leading types of manufacturing plants in the region (in 2002) were printing and related support activities; fabricated metal products; miscellaneous products; and food products.

1.4.6 Trades and Services⁸

In 2002, wholesale trade, retail trade, and services contributed over \$59 billion in sales or receipts and provided 450,148 jobs in the South Central Texas Region (Table 1-10).⁹ Wholesale trade accounted for 31.5 percent of the total sales or receipts and provided 6.9 percent of the jobs within the trades and services classification in 2002. The leading type of wholesale trade within the South Central Texas Region is durable goods, which includes automobile parts and supplies; lumber and construction materials, and machinery, equipment, and supplies. In 2002, the leading counties in wholesale trade were Bexar, Victoria, Guadalupe, and Comal.

⁶ Source: 2002 Census of Manufacturing, U.S. Department of Commerce.

⁷ Data for 2002 are the most recent data available.

⁸ Source: 2002 Economic Census, U.S. Department of Commerce.

⁹ Data for 2002 are the most recent data available.

Table 1-9.
Summary of Manufacturing Activity — 2002
South Central Texas Region

County	Total Number of Establishments	Total Number of Employees	Value of Shipments (million dollars)
Atascosa	0	0	\$0
Bexar	1,019	35,121	\$6,290
Caldwell	0	0	\$0
Calhoun	22	3,815	\$2,689
Comal	101	3,272	\$611
DeWitt	27	847	\$114
Dimmit	0	0	\$0
Frio	0	0	\$0
Goliad	0	0	\$0
Gonzales	20	1,131	\$197
Guadalupe	100	5,224	\$1,547
Hays (part) ¹	113	2,618	\$514
Karnes	0	0	\$0
Kendall	41	818	\$157
LaSalle	0	0	\$0
Medina	21	538	\$42
Refugio	0	0	\$0
Uvalde	0	0	\$0
Victoria	75	3,064	\$1,245
Wilson	0	0	\$0
Zavala	0	0	\$0
Region Total	1,539	56,448	\$13,406
¹ Estimated that 90 percent of Hays County's total manufacturing industry is located within the planning region. Source: 2002 Economic Census, U.S. Department of Commerce.			

Table 1-10.
Trades and Services Industry — 2002
South Central Texas Region

County	Total Number of Establishments	Total Number of Employees	Value of Shipments (million dollars)
Atascosa	381	4,357	\$496
Bexar	22,487	358,555	\$47,486
Caldwell	335	2,514	\$262
Calhoun	285	1,509	\$187
Comal	1,513	14,846	\$1,901
DeWitt	270	2,385	\$282
Dimmit	117	974	\$92
Frio	154	1,280	\$168
Goliad	70	282	\$31
Gonzales	254	1,920	\$307
Guadalupe	1,045	11,592	\$1,666
Hays (part) ¹	1,190	14,275	\$1,575
Karnes	165	1,369	\$174
Kendall	583	4,065	\$717
LaSalle	62	282	\$47
Medina	406	3,315	\$455
Refugio	93	723	\$87
Uvalde	401	3,992	\$556
Victoria	1,589	19,208	\$2,517
Wilson	263	2,420	\$190
Zavala	72	285	\$35
Region Total	31,735	450,148	\$59,231
¹ Estimated that 70 percent of Hays County's trades and services industry is located within the planning region. Source: 2002 Economic Census, U.S. Department of Commerce.			

Retail trade accounted for 37.4 percent of the total sales or receipts and provided 22.6 percent of the jobs within the trades and services classification in 2002. The leading types of retail trade within the South Central Texas Region are apparel and accessory stores, gas stations, motor vehicle and parts stores, and food and beverage stores. In 2002, the leading counties in retail trade were Bexar, Victoria, Hays, and Comal.

Services accounted for 31.1 percent of the total sales or receipts and provided 70.5 percent of the jobs within the trades and services classification in 2002. The leading types of services within the South Central Texas Region are healthcare and social services, professional and technical services, and accommodation and food services.

1.5 Water Uses¹⁰

Water use in 2000 within the South Central Texas Region is summarized for each of the river and coastal basin areas of the region in the following paragraphs.

In 2000, total water use in that part of the Rio Grande Basin located in the South Central Texas Region (part of Dimmit County) was approximately 107 acre-feet (acft) of which 2 acft (2 percent) was used for municipal-type (household) purposes, while the remaining 105 acft was for livestock watering.

In the South Central Texas Region portion of the Nueces River Basin, groundwater resources supply about 90 percent of the water used for all purposes in the basin, with surface water resources supplying the remaining 10 percent. In 2000, total water use within the South Central Texas Region of the basin was 367,959 acft. Irrigated agriculture accounts for nearly 87 percent of all the water used in that portion of the Nueces River Basin located in the planning region, while municipal water use accounts for only about 8 percent.

In the San Antonio River Basin, groundwater resources supply about 91 percent of the water used for all purposes, with surface water resources supplying the remaining 9 percent. In 2000, water use for municipal, industrial, and agricultural purposes within the South Central Texas Region totaled 336,944 acft. Municipal water use accounts for about 73 percent of all water use in that portion of the basin located in the planning region, with water used for irrigated agriculture accounting for about 13 percent. Groundwater resources supply about 99 percent of

¹⁰ Data provided by the TWDB.

the water for municipal use in the basin and about 72 percent of the water used for irrigated agriculture.

In the Guadalupe River Basin, groundwater resources supply about 30 percent of the water used for all purposes, with surface water resources supplying the remaining 70 percent. Total basin water use in 2000 was 120,930 acft within the South Central Texas Region. Municipal is the largest water use category in that part of the basin located within the planning region, accounting for more than 45 percent of the total water use, followed by manufacturing, which accounts for about 29 percent.

In 2000, total water use in that part of the Lower Colorado River Basin located in the South Central Texas Region (parts of Caldwell and Kendall Counties) was approximately 562 acft. Of this total, 365 acft (64.9 percent) was used for municipal purposes, 15 acft (2.7 percent) for irrigation purposes, 13 acft (2.3 percent) for mining purposes, and the remaining 169 acft for livestock purposes.

Total basin water use in 2000 for the South Central Texas portion of the Lavaca River Basin was 867 acft. Municipal water use accounts for about 59.2 percent of all water use in that portion of the basin located in the planning region, followed by livestock use, which accounts for 35.8 percent.

In 2000, water use for municipal, industrial, and livestock purposes in that portion of the Colorado-Lavaca Coastal Basin located in the South Central Texas Region totaled 20,128 acft. Industrial water use is the largest in that part of the basin located within the planning area, accounting for nearly 99 percent of all water used.

In the South Central Texas portion of the Lavaca-Guadalupe Coastal Basin, annual water use totaled 45,693 acft in 2000. The largest water-using category in that part of the basin located within the planning region is manufacturing, which accounts for about 51 percent of all water used.

In the South Central Texas portion of the San Antonio-Nueces Coastal Basin, annual water use totaled about 3,162 acft in 2000. The largest water use category in that part of the basin located within the planning region is municipal, which accounts for about 40 percent of all water used.

1.6 Wholesale Water Providers

The Texas Water Development Board's (TWDB) definition of a Wholesale Water Provider (WWP) is as follows:

“A WWP is any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 acft of water wholesale in any one year during the five years immediately preceding the adoption of the last Regional Water Plan.”

Under this definition, the list of WWPs for the South Central Texas Region is as follows:

- San Antonio Water System (SAWS),
- Bexar Metropolitan Water District (BMWD),
- Guadalupe-Blanco River Authority (GBRA),
- Canyon Regional Water Authority (CRWA),
- Schertz-Seguin Local Government Corporation (SSLGC), and
- Springs Hill Water Supply Corporation (SHWSC).

In addition, the recently-formed Texas Water Alliance (TWA) is included as a WWP because it is expected to enter into contracts to sell more than 1,000 acft/yr wholesale during the planning period. Each wholesale water provider is briefly described in the following sections. Detailed water demand projections for each wholesale water provider are presented in Section 2.10.

1.6.1 San Antonio Water System

The San Antonio Water System (SAWS) is a public utility owned by the City of San Antonio, and its primary water supply source is the Edwards Aquifer. Additional sources include the Carrizo and Trinity Aquifers, Canyon Reservoir, and direct reuse. SAWS has 260,000 separate customers, and serves approximately 1 million people in the urbanized portion of Bexar County. The water supply service area includes most, but not all, of the City of San Antonio, several suburban municipalities, and adjacent areas of Bexar County. In addition to serving its own retail customers, SAWS also provides wholesale water supplies to several utility systems within Bexar County (Section 2.10). SAWS is in the process of developing supplies from other sources, including groundwater from the Carrizo-Wilcox Aquifer and surface water from the Nueces, Guadalupe-San Antonio, and Colorado River Basins and San Antonio Bay.

1.6.2 Bexar Metropolitan Water District

Created in 1945 by the Texas State Legislature, Bexar Metropolitan Water District (BMWD) serves a population of more than 250,000 in the City of San Antonio and other areas in Bexar, Atascosa, and Medina Counties. It is the second-largest water supplier in Bexar County and, at present, obtains most of its water from the Edwards Aquifer with additional supplies from the Trinity and Carrizo Aquifers, the Medina Lake System, and run-of-river water rights on the Medina River. BMWD is in the process of developing supplies from other sources including additional groundwater from the Carrizo and Trinity Aquifers and surface water from the Guadalupe-San Antonio River Basin.

1.6.3 Guadalupe-Blanco River Authority

The Guadalupe-Blanco River Authority (GBRA) was created by the Texas Legislature in 1933 for the purposes of developing, storing, preserving, and distributing the waters of the Guadalupe River Basin for all useful purposes. GBRA is a regional entity serving Hays, Comal, Guadalupe, Caldwell, Gonzales, DeWitt, Victoria, Kendall, Refugio, and Calhoun Counties. GBRA's activities include supplying hydroelectric power through operations of six hydroelectric dams located on the Guadalupe River in Guadalupe and Gonzales Counties, supplying potable water, treatment of wastewater, and supplying raw water through management of substantial run-of-river rights and storage rights in Canyon Reservoir. GBRA is in the process of developing water supplies from sources including surface water in the Guadalupe-San Antonio River Basin and groundwater from the Simsboro Aquifer, and developing transmission and treatment facilities to deliver these supplies to customers.

1.6.4 Canyon Regional Water Authority

Canyon Regional Water Authority (CRWA) is a subdivision of the State of Texas created by the Texas Legislature in 1989. CRWA is the water planning and development agency for water purveyors that serve large areas of Guadalupe County and portions of Bexar, Hays, Caldwell, Wilson, and Comal Counties. It works as a partnership of 12 water supply corporations, cities, and districts responsible for acquiring, treating, and transporting potable water (Section 2.10). CRWA owns and operates treatment plants at Lake Dunlap on the Guadalupe River and in far western Caldwell County near the San Marcos River for surface water purchased from the GBRA or leased from other water rights owners. CRWA is pursuing

the development of additional water supplies including groundwater from the Carrizo and Wilcox Aquifers and surface water from Cibolo Creek.

1.6.5 Schertz-Seguin Local Government Corporation

The Cities of Schertz, located partially in Guadalupe County and partially in Bexar County, and Seguin, located in Guadalupe County, have joined to create the Schertz-Seguin Local Government Corporation (SSLGC). This Corporation is responsible for creating and operating a wholesale water supply system to serve the long-term needs of these two communities. In addition the Corporation sells water to Selma, Universal City, Garden Ridge, and Springs Hill WSC (Section 2.10). The Carrizo Aquifer in Gonzales and Guadalupe Counties is the current source of supply for SSLGC. SSLGC is pursuing the development of additional water supplies from the Carrizo and Wilcox Aquifers.

1.6.6 Springs Hill WSC

Springs Hill Water Supply Corporation (WSC) is a retail and wholesale water supplier serving customers located primarily in Guadalupe County. In addition to serving its own customers, Springs Hill WSC also supplies water to La Vernia (via CRWA), Crystal Clear WSC, and East Central WSC (via CRWA). Springs Hill WSC's current water supply sources include water from Canyon Reservoir (supplied by GBRA and CRWA), and the Carrizo Aquifer (self-supplied and purchased from SSLGC) (Section 2.10). Springs Hill WSC is pursuing development of additional water supplies from the Carrizo and Wilcox Aquifers.

1.6.7 Texas Water Alliance

The Texas Water Alliance (TWA) is a group of landowners located in northeast Gonzales County organized for the purpose of selling groundwater on a wholesale basis to wholesale water providers (WWPs) and water user groups (WUGs) most likely located in the South Central Texas Regional Water Planning Area (Region L). To date, all of the listed WWPs and several WUGs (i.e. Canyon Lake WSC, Gonzales County WSC, San Marcos, and Kyle) in Region L have shown some measure of interest in groundwater supplies potentially available from northeast Gonzales County. It is highly uncertain at this time which one or more of these entities will enter into water supply agreements with the TWA and/or other proximate landowners and whether necessary production permits can be obtained from the Gonzales County Underground

Water Conservation District for use of this groundwater. Hence, for the purposes of this regional water plan, the TWA is designated a WWP to ensure the flexibility necessary to facilitate the activities of individual sponsors and/or coalitions of sponsors in their independent or collective efforts to develop water supplies from groundwater sources in northeast Gonzales County.

1.7 Water Resources and Quality Considerations

1.7.1 Groundwater¹¹

There are five major and minor aquifers supplying water to the South Central Texas Region. The five major aquifers are the Edwards, Carrizo, Trinity, Gulf Coast, and Edwards-Trinity (Plateau) Aquifers (Figure 1-5). The three minor aquifers are the Sparta, Queen City, and Yegua-Jackson Aquifers. Each aquifer is described and a general assessment of water quality is provided in the following subsections¹². A summary of estimated groundwater supplies is presented in Section 3.

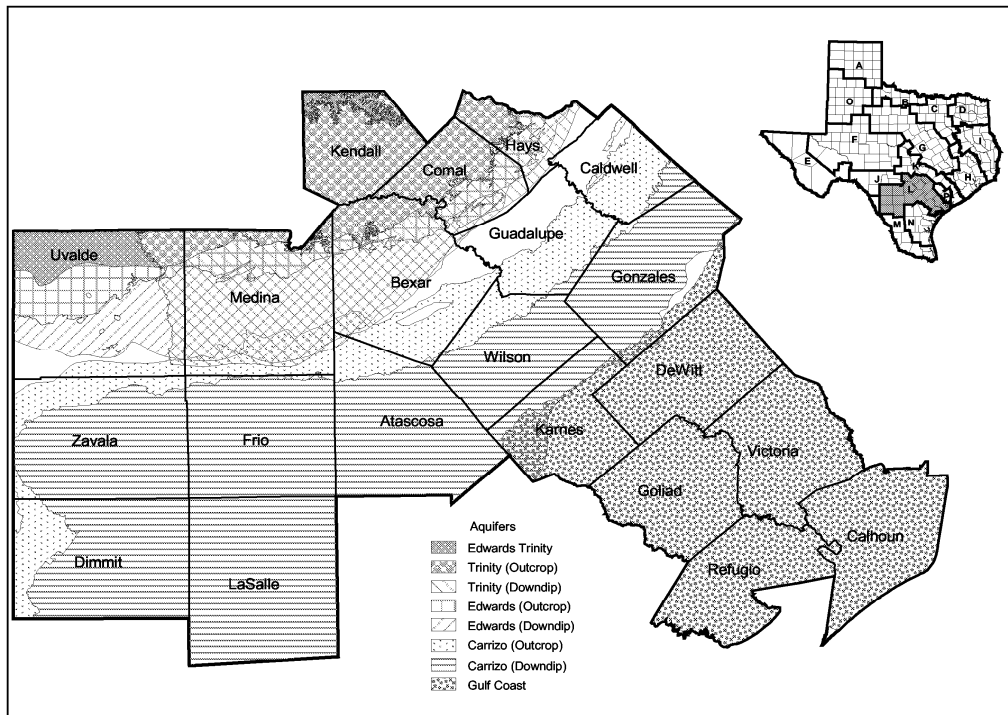


Figure 1-5. Major Aquifers — South Central Texas Region

¹¹ “Ground-water Availability in Texas,” Texas Department of Water Resources, Austin, Texas, September 1979.

¹² Summary descriptive information regarding the Yegua-Jackson Aquifer is available in “Water for Texas 2007” prepared and published by the Texas Water Development Board. Information is not included herein as existing supplies from this aquifer are not known to be relied upon in Region L and no water management strategies contemplate its use in Region L.

1.7.1.1 Edwards-Balcones Fault Zone Aquifer (Edwards Aquifer)

The Edwards Aquifer underlies parts of nine counties (Uvalde, Medina, Bexar, Atascosa, Comal, Guadalupe, Hays, Frio, and Zavala) in the South Central Texas Region. The aquifer forms a narrow belt extending from a groundwater divide in Kinney County through the San Antonio area northeastward to the Leon River in Bell County. A groundwater divide near Kyle, in Hays County, hydrologically separates the aquifer into the San Antonio and the Austin regions except during severe drought. The name Edwards-BFZ distinguishes this aquifer from the Edwards-Trinity (Plateau) and the Edwards-Trinity (High Plains) Aquifers, however, in this document, it will be referred to as the Edwards Aquifer (Figure 1-5).

The Edwards Aquifer supplied approximately 44 percent of the total water used in the South Central Texas Region in 2000. Water demands of the area that is now being supplied from the Edwards Aquifer are growing at a rate of approximately 1.7 percent per year. Present levels of use cannot be sustained during a repeat of the drought of record without interruption of flow at Comal Springs. Maintenance of adequate levels of flows at Comal and San Marcos Springs are desirable to support habitats of endangered species and provide for downstream water rights.

Water from the aquifer is primarily used for municipal, irrigation, and industrial purposes. In 2008, approximately 62 percent of the total water pumped from the aquifer in the region was used for municipal supply, with 26 percent used for irrigation purposes, 7 percent used for industrial purposes, and an estimated 5 percent used for domestic and livestock purposes and federal facilities.¹³ San Antonio, which presently obtains the vast majority of its municipal water supply from the aquifer, is the largest city in the United States and one of the largest in the world that has relied on a single groundwater source. The Edwards Aquifer also supplies water to industries in the San Antonio area and is the source of flow from Comal, San Marcos, Leona, San Antonio, and San Pedro Springs. Both the Guadalupe and San Antonio Rivers are supplied with base flows from springs, which, in turn, are used downstream for municipal, industrial, and agricultural purposes.

The aquifer, composed predominantly of limestone formed during the early Cretaceous Period, exists under water-table conditions in the outcrop and under artesian conditions where it is confined below the overlying Del Rio Clay. The Aquifer consists of the Georgetown Limestone, formations of the Edwards Group (the primary water-bearing unit) and their

¹³ Edwards Aquifer Authority, "Hydrologic Data Report for 2008," July 2009.

equivalents, and the Comanche Peak Limestone where it exists. Saturated thickness ranges from 200 to 600 feet.

Recharge to the aquifer occurs primarily by the downward percolation of surface water from streams draining off of the Edwards Plateau to the north and west and by direct infiltration of precipitation on the outcrop. This recharge reaches the aquifer through crevices, faults, and sinkholes in the unsaturated zone. Unknown amounts of groundwater enter the aquifer as lateral underflow from the Glen Rose Formation. Water in the aquifer generally moves from the recharge zone toward natural discharge points such as Comal and San Marcos Springs. Water is withdrawn through hundreds of wells, particularly municipal and industrial wells in Bexar, Comal, and Hays Counties, and irrigation wells in Bexar, Medina, and Uvalde Counties.

In the updip portion, groundwater moving through the aquifer system has dissolved large volumes of rock to create highly permeable solution zones and channels that facilitate rapid flow and relatively high storage capacity within the aquifer. Highly fractured strata in fault zones have also been preferentially dissolved to form conduits capable of transmitting large amounts of water. Due to its extensive honeycombed and cavernous character, the aquifer yields moderate to large quantities of water to wells, with some wells yielding in excess of 16,000 gallons per minute (gpm) (35.6 cfs, 25,810 acft/yr). One well drilled in Bexar County flowed 24,000 gpm (53.5 cfs, 38,720 acft/yr) from a 30-inch diameter pipe. The aquifer is significantly less permeable farther downdip where the concentration of dissolved solids in the water exceeds 1,000 milligrams per liter (mg/L).

Due to its highly permeable nature in the fresh-water zone, the Edwards Aquifer responds quickly to changes and extremes of stress placed on the system. This is indicated by rapid water-level fluctuations during relatively short periods of time. During times of high rainfall and recharge, the Edwards Aquifer is able to supply significant quantities of water for municipal, industrial, and irrigation uses, as well as sustain springflows. However, under conditions of below-average rainfall or drought, when discharge and withdrawals exceed recharge, springflows may decline to levels that are unacceptable to both environmental and downstream water rights concerns.

Operations of the largest existing surface water supply sources in the South Central Texas Region are linked to the Edwards Aquifer. Dependable supplies from Canyon Reservoir for municipal and industrial customers are a function of springflows from the Edwards Aquifer, since inflow passage through Canyon Reservoir is necessary to meet downstream senior water

rights when springflows drop below certain levels. Storage in the Medina Lake System contributes significantly to recharge of the Edwards Aquifer, and reservoirs used to provide cooling for steam-electric power generation (Coletto Creek, Calaveras, and Braunig) are dependent to some degree upon springflows and/or treated municipal effluent, which originated from the Edwards Aquifer. Surface water supplies available to the region are also a function of recharge to and withdrawal from the Edwards and other aquifers, as well as the quantities of streamflows permitted for use in counties of the Nueces River Basin outside the South Central Texas Region.

An important management issue for the Edwards Aquifer includes establishing levels of groundwater withdrawals and enhancing natural recharge to ensure adequate water levels and at least minimum springflows. In the three river basin area where the Edwards Aquifer is located, growing demands are increasing the competition for scarce water resources. Aquifer recharge and pumpage affect streamflows and springflows, which in turn affect endangered species at and below the springs, streamflows for downstream water rights holders, instream flows for fish and wildlife, and freshwater inflows to the Guadalupe Estuary.

In 1959, after the severe drought and increasing pumpage from 1950 to 1957 that lowered water levels in the aquifer to record lows and caused Comal Springs in Comal County to go dry for several months, the Texas Legislature created the Edwards Underground Water District. The district included Bexar, Comal, Hays, Medina, and Uvalde Counties and was charged with conserving, protecting, and recharging the underground water-bearing formations within the district and preventing waste and pollution of such underground water. In 1989, Medina and Uvalde Counties withdrew from the district and each formed a countywide district. In 1993, while under threat of federal intervention for alleged failure to protect federally protected species that rely on springflows from the Edwards Aquifer, the Texas Legislature enacted Senate Bill 1477.

Senate Bill 1477 abolished the Edwards Underground Water District and created a new entity, the Edwards Aquifer Authority. Senate Bill 1477 directs the Authority to implement a comprehensive management plan for the aquifer that regulates pumpage, while taking into consideration the interests and needs of all the individuals and entities that rely on the aquifer as a water source, and maintains the delicate relationship between springflows and the environment. In 2007, Senate Bill 3 of the 80th Texas Legislature established a maximum annual amount of permitted withdrawals from the aquifer, specific critical period management plan provisions,

interim minimum annualized rates for permitted withdrawals in the critical period, and a Recovery Implementation Program for protection of endangered species.

A “bad water” line generally runs west-east through southern Uvalde and Medina Counties, the northern tip of Atascosa County, Southeastern Bexar, Comal, and Hays Counties, and the western tip of Guadalupe County.¹⁴ South and southeast of the “bad water” line, the aquifer contains water having more than 1,000 milligrams per liter of dissolved solids. The potential for movement of this poor quality water into the fresh water zone, as fresh water levels are lowered during periods of low recharge and high pumpage, is considered a threat to the quality of water in the fresh water zone of the aquifer, and consequently may be a threat to the water supplies of those who depend upon the aquifer.

1.7.1.2 Carrizo-Wilcox Aquifer (Carrizo Aquifer)

The Wilcox Group, including the Calvert Bluff, Simsboro, and Hooper Formations, and the overlying Carrizo Formation of the Claiborne Group, form a hydrologically connected system known as the Carrizo-Wilcox Aquifer, which is referred to in this plan as the Carrizo Aquifer. This aquifer extends from the Rio Grande in South Texas northeastward into Arkansas and Louisiana, providing water to all or parts of 60 counties in Texas, 13 of which are located in the South Central Texas Region. The Carrizo Sand and Wilcox Group outcrop along a narrow band that is located about 130 miles inland from the Gulf of Mexico at the eastern edge of the South Central Texas Region and about 200 miles inland at the western edge. The aquifer dips beneath the land surface toward the coast.

The Carrizo Aquifer is predominantly composed of sand locally interbedded with gravel, silt, clay, and lignite deposited during the Tertiary Period. Water-bearing thickness of the aquifer ranges from 200 feet in Dimmit County to more than 1,500 feet in the downdip artesian portion in Atascosa County. Where it is found at the surface, the aquifer exists under water-table conditions and, in the subsurface, is under artesian conditions. Yields of wells are commonly 500 gpm (1.1 cfs, 810 acft/yr), and some may reach 3,000 gpm (6.7 cfs, 4,840 acft/yr) downdip where the aquifer is under artesian conditions. Some of the greatest yields are produced from the Carrizo Sand in the southern, or Winter Garden, area of the aquifer.

¹⁴ “Groundwater Resources, and Model Applications for the Edwards (Balcones Fault Zone) Aquifer in the San Antonio Region, Texas,” Texas Department of Water Resources, Klemm, William B., Tommy R. Knowles, Glenward R. Elder, and Thomas W. Sieb, Report 239, Austin, Texas, October 1979.

Historically, municipal and irrigation pumpage account for about 35 percent and 51 percent, respectively, of total pumpage from the Carrizo Aquifer within the region, with irrigation being the predominant use in the Winter Garden region. Significant water-level declines have occurred in the semiarid Winter Garden portion of the Carrizo Aquifer, as the region is heavily dependent on groundwater for irrigation. Since 1920, water levels have declined 100 feet in much of the area and more than 250 feet in the Crystal City area of Zavala County.

In the South Central Texas Region, water from the Carrizo Aquifer is fresh to slightly saline. In the outcrop, the water is hard yet usually low in dissolved solids. Downdip, the water is softer, has a higher temperature, and contains more dissolved solids. A downdip “bad water” line generally runs northeast-southwest through the southeast portion of La Salle and McMullen Counties, the northeast portion of Live Oak and Karnes Counties, and southeast Gonzales County. Southeast of the “bad water” line the groundwater has more than 1,000 mg/L of total dissolved solids. Localized contamination of the aquifer in the Winter Garden region is attributed to direct infiltration of oil field brines on the surface and to downward leakage of saline water from the overlying Bigford Formation. Some sampled wells in Dimmit and Zavala Counties were found to contain high concentrations of dissolved solids, chloride, and/or sulfate. Downward leakage of more highly-mineralized water from overlying strata through the uncemented annular space between the well casings and boreholes of such wells is considered to be the most likely cause. Nitrate and gross alpha above maximum concentration limits have been observed in the Winter Garden District. Caldwell and Gonzales Counties have areas where water from the aquifer is high in iron and manganese. The Calvert Bluff, Simsboro, and Hooper formations of the Wilcox group all contain mean iron concentrations greater than the secondary drinking water standard of 0.3 mg/L. Water from all three formations is hard to very hard. Mean concentrations of sulfate and chloride are below regulatory standards in all three formations.

1.7.1.3 Trinity Aquifer

The Trinity Aquifer provides water to all or parts of 55 counties in Texas, including six counties (Hays, Comal, Kendall, Bexar, Medina, and Uvalde) in the South Central Texas Region. The Trinity Aquifer consists of early Cretaceous Age formations of the Trinity Group that are organized into the lower Trinity Aquifer (Hosston Sand and Sligo Limestone), the middle Trinity Aquifer (lower Glen Rose Limestone, the Hensell Sand, and Cow Creek Limestone), and the

upper Trinity Aquifer (upper Glen Rose Limestone).¹⁵ Because of its depth and poor quality, the lower Trinity has not been extensively developed. The middle Trinity is the most widely used part of the aquifer in the South Central Texas Region. The upper Trinity yields are low due to low porosity and permeability, and water quality is poor due to the presence of evaporate beds.

Trinity well yields are rarely more than 100 gpm (0.22 cfs, 160 acft/yr) in the South Central Texas Region although the SAWS is presently obtaining an average of about 500 gpm from several Trinity wells in northern Bexar County. At the present time, the aquifer is being stressed due to rapid growth in the number of wells being drilled to supply new homes and commercial establishments. Due to the heavy demands being placed upon the aquifer in relation to supplies available, much of the area underlain by the Trinity Aquifer in the Hill Country has been included in a Priority Groundwater Management Area.

Water quality from the Trinity Aquifer is acceptable for most municipal and industrial purposes; however, excess concentrations of certain constituents in many places exceed drinking water standards for municipal supplies. In the southern Hill Country region, the primary contribution to poor quality is wells that have not been adequately cased through the evaporite beds in the upper part of the Glen Rose. Water quality naturally deteriorates in the downdip direction within all the Trinity water-bearing units. A downdip “bad water” line for the Trinity Aquifer generally trends east-west through southern Uvalde and Medina Counties, then trends southeast-northwest through central Bexar County and the southeast edge of Comal and Hays Counties. South and southeast of this “bad water” line, the groundwater contains greater than 1,000 mg/L of total dissolved solids. Average concentrations of nitrates, fluorides, chlorides, and sulfates are below regulatory standards. However, localized areas of nitrate pollution due to human or animal waste, and ranching and farming activities have been identified in parts of Kendall and Hays Counties.

1.7.1.4 Gulf Coast Aquifer

The Gulf Coast Aquifer forms a wide belt along the Gulf of Mexico from Florida to Mexico. In Texas, the aquifer provides water to all or parts of 54 counties, including all or parts of seven coastal counties (Karnes, Gonzales, DeWitt, Goliad, Victoria, Refugio, and Calhoun) in

¹⁵ “Groundwater Availability of the Lower Cretaceous Formations in the Hill Country of South-Central Texas,” Texas Department of Water Resources, Austin, Texas, 1983.

the South Central Texas Region. Municipal and irrigation uses have historically accounted for 90 percent of the total pumpage for the aquifer in the planning region.

The aquifer consists of complex interbedded clays, silts, sands, and gravels of the Cenozoic Age, which are hydrologically connected to form a large, leaky artesian aquifer system. This system is comprised of four major components consisting of the following generally recognized water-producing formations. The deepest is the Catahoula, which contains groundwater near the outcrop in relatively restricted sand layers. Above the Catahoula, is the Jasper Aquifer, primarily contained within the Oakville Sandstone. The Burkeville confining layer separates the Jasper from the overlying Evangeline Aquifer, which is contained within the Fleming and Goliad Sands. The Chicot Aquifer, or upper component of the Gulf Coast Aquifer system, consists of the Lissie, Willis, Bentley, Montgomery, and Beaumont Formations, and overlying alluvial deposits. Not all formations are present throughout the system, and nomenclature often differs from one end of the system to the other. In the South Central Texas Region, saturated thickness ranges from 500 feet in Karnes County to about 1,500 feet in Victoria County. Average well yields are about 1,600 gpm. Water quality tends to deteriorate from about 500 mg/L of dissolved solids in Karnes County to over 1,000 mg/L near the coast. Water levels have declined in local areas where significant withdrawals have been made for municipal, industrial, and irrigation purposes. As water levels decline, the threats of land subsidence and salt-water intrusion increase.

In the Gulf Coast Aquifer, water quality is generally good in the shallower portion of the aquifer. Groundwater containing less than 500 mg/L dissolved solids is usually encountered to a maximum depth of 3,200 feet in the aquifer from the San Antonio River basin northeastward to Louisiana. From the San Antonio River Basin southwestward to Mexico, quality deterioration is evident in the form of increased chloride concentration and salt-water encroachment along the coast. Little of this groundwater is suitable for prolonged irrigation use due to either high salinity, or alkalinity, or both. The downdip extent of fresh water in the Gulf Coast Aquifer is approximately equal to or somewhat inland from the coast line of the Gulf of Mexico. Elevated levels of TDS, chloride, and/or arsenic can occur locally (e.g., Karnes, Refugio, and Calhoun Counties) necessitating more advanced treatment processes.

1.7.1.5 Edwards-Trinity (Plateau) Aquifer

The Edwards-Trinity (Plateau) Aquifer provides water to the northern portions of Uvalde and Kendall Counties in the South Central Texas Region. The aquifer consists of saturated sediments of lower Cretaceous Age Trinity Group, including the Fredericksburg Group and Washita Group.¹⁶ The Glen Rose Limestone is the primary unit in the Edwards-Trinity (Plateau) Aquifer in the southern areas of its extent. This unit is estimated to have a thickness of up to 300 feet in these southern areas of its extent.

The aquifer generally exists under water-table conditions, however, where the Trinity (Plateau) Aquifer is fully saturated and a zone of low permeability occurs near the base of the overlying Edwards, artesian conditions may exist. Reported well yields commonly range from less than 50 gpm where saturated thickness is thin to more than 1,000 gpm where wells are completed in jointed and cavernous limestone. Water quality ranges from fresh to slightly saline. The water is generally hard and varies in concentrations of calcium, magnesium, and bicarbonate. Average concentrations of nitrate, fluoride, chloride, and sulfates are below regulatory drinking water standards.

1.7.1.6 Sparta Aquifer

The Sparta Aquifer extends in a narrow band from the Frio River in South Texas northeastward to the Louisiana border, and underlies parts of five counties (Frio, LaSalle, Atascosa, Wilson, and Gonzales) in the South Central Texas Region. The southwestern boundary is placed at the Frio River because of a facies change in the formation, which makes it difficult to delineate the boundaries of the Sparta and contiguous formations southwestward. The facies change results in reduced amounts of water and poorer quality water being produced from the interval. The Sparta provides water for domestic and livestock supply throughout its extent in the region.

The Sparta Formation, part of the Claiborne Group deposited during the Tertiary, consists of sand and interbedded clay with massive sand beds in the basal section. These beds gently dip to the south and southeast toward the Gulf Coast and reach a total thickness of up to 300 feet. Usable quality water is commonly found within the outcrop and for a few miles downdip and in some areas may occur down to depths approaching 2,000 feet. Yields of individual wells are

¹⁶ Barker, Rene A., and Ardis, Ann F., "Hydrogeologic Framework of the Edwards-Trinity Aquifer System, West Central Texas," USGS Professional Paper 1421-B, 1996.

generally less than 100 gpm, although some wells average 400 to 500 gpm, and a few wells produce as much as 1,200 gpm. Water occurs under water-table conditions in the outcrop and under artesian conditions downdip where the Sparta is covered by younger, non water-bearing rocks.

The Sparta Aquifer produces water of excellent quality throughout most of its extent in the South Central Texas Region; however, water quality deteriorates with depth due to high chlorides and dissolved solids in the downdip direction. The extent of downdip fresh water in the Sparta Aquifer generally runs along a line trending southwest-northeast from northern La Salle and McMullen Counties through southeast Atascosa and Wilson Counties to central Gonzales County. In some locations, water within the aquifer may contain iron concentrations in excess of secondary drinking water standards.

1.7.1.7 Queen City Aquifer

The Queen City Aquifer extends across Texas from the Frio River in South Texas northeastward into Louisiana and underlies six counties (Frio, LaSalle, Atascosa, Wilson, Gonzales, and Caldwell) in the South Central Texas Region. The southwestern boundary is placed at the Frio River because of a facies change in the formation. This facies change results in reduced amounts of poorer quality water produced from this interval southwest of the Frio River. The aquifer provides water for domestic and livestock purposes throughout most of its extent and water for irrigation in Wilson County.

Sand, loosely cemented sandstone, and interbedded clay units of the Queen City Formation of the Tertiary Claiborne Group make up the aquifer. These rocks dip gently to the south and southeast toward the Gulf Coast. Total aquifer thickness is usually less than 500 feet. In the outcrop area, water occurs under water-table conditions, while in the downdip subsurface, where the Queen City is covered by younger, non-water-bearing rocks, the water is under artesian conditions. Yields of individual wells are commonly low, but a few exceed 400 gpm.

Water of excellent quality is generally found within the outcrop and for a few miles downdip, but water quality deteriorates with depth in the downdip direction due to high chlorides and dissolved solids. The extent of downdip fresh water in the Queen City Aquifer is approximately the same as the Sparta Aquifer in the previous subsection. Queen City Aquifer groundwater contains relatively high iron concentrations in some locations.

1.7.2 Surface Water

The South Central Texas Region includes parts of the Rio Grande, Nueces, San Antonio, Guadalupe, Colorado, and Lavaca River Basins and parts of the Colorado-Lavaca, Lavaca-Guadalupe, and San Antonio-Nueces Coastal Basins (Figure 1-6). Existing surface water supplies of the region include those derived from storage reservoirs and run-of-river water rights. The geographical characteristics of the various river basins are described in the following subsections, along with major reservoirs and/or water rights. In addition, general information is provided regarding water quality characteristics and specific notation is made of stream segments on the 2008 draft list prepared by the Texas Commission on Environmental Quality (TCEQ) pursuant to Section 303(d) of the Federal Clean Water Act. Appearance on this list indicates the possibility that a stream or water body does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants which could lead to a Total Maximum Daily Load (TMDL) assessment. Existing surface water supplies available during drought are summarized in Section 3.

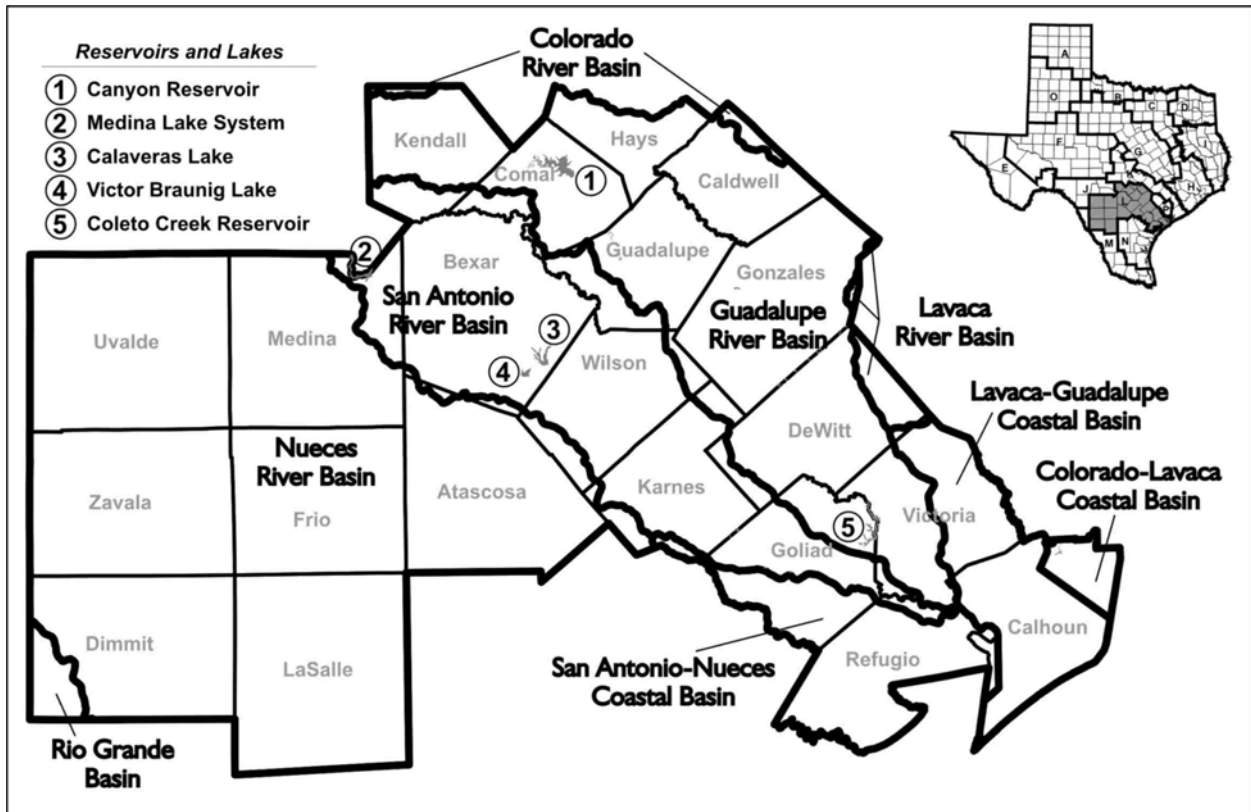


Figure 1-6. River Basins, Coastal Basins, and Reservoirs of the South Central Texas Region

1.7.2.1 Rio Grande Basin

The southwestern corner of Dimmit County, an area of approximately 164 square miles, is located in the Rio Grande Basin and in the South Central Texas Region. The only surface water presently available to this area is that which can be captured in stock tanks.

1.7.2.2 Nueces River Basin

The Nueces River Basin is bounded on the north and east by the Colorado, San Antonio, and Guadalupe River Basins and the San Antonio-Nueces Coastal Basin, and on the west and south by the Rio Grande Basin and the Nueces-Rio Grande Coastal Basin. Total drainage area of the basin is about 16,920 square miles above Calallen Dam, of which 8,973 square miles are located in the South Central Texas planning region. The Nueces River rises in Edwards County and flows 371 river miles from the gage at Laguna in Uvalde County to Nueces Bay on the Gulf of Mexico near Corpus Christi. Principal tributaries of the Nueces River are the Frio and Atascosa Rivers. Major population centers located in the basin include the cities of Uvalde (Uvalde County), Crystal City (Zavala County), Pearsall (Frio County), Pleasanton (Atascosa County), Hondo (Medina County), and Carrizo Springs (Dimmit County). Major water rights in the Nueces River Basin within the South Central Texas Region include those held by the Zavala-Dimmit County WCID #1, which total 28,000 acft/yr.

Water quality in the upper portion of the Nueces River Basin in the less-inhabited reaches is good, except for relatively high nitrate-nitrogen levels occurring naturally in the spring-fed streams. A substantial part of the flow of the upper Nueces River and its tributaries upstream of the Edwards Aquifer recharge zone enters the fractured and cavernous limestone formation of the Edwards Aquifer. As a result, streamflows in the Nueces River Basin downstream from the recharge zone consist almost entirely of stormwater. During low-flow conditions, chloride, sulfate, and total dissolved solids levels increase due to natural and human activities. The Atascosa River has experienced elevated bacteria, depressed dissolved oxygen levels, and impaired fish communities downstream of the City of Pleasanton. Elevated bacteria levels have been observed in the Frio and Leona Rivers and in San Miguel Creek, but additional data and information are needed before a TMDL may be scheduled.

1.7.2.3 San Antonio River Basin

The San Antonio River Basin is bounded on the north and east by the Guadalupe River Basin and on the west and south by the Nueces River Basin and the San Antonio-Nueces Coastal Basin. Total drainage area of the basin is about 4,180 square miles, of which 3,506 square miles are located in the planning region. The San Antonio River has its source in large springs within and near the city limits of San Antonio. The river flows more than 230 river miles across the Coastal Plain to a junction with the Guadalupe River near the Gulf of Mexico. Its principal tributaries are the Medina River and Cibolo Creek, both spring-fed streams. Major population centers located in the basin include the cities of San Antonio (Bexar County), Universal City (Bexar County), Schertz (Bexar County), Live Oak (Bexar County), Leon Valley (Bexar County), Converse (Bexar County), Kirby (Bexar County), Alamo Heights (Bexar County), and Floresville (Wilson County). The largest water rights in the San Antonio River Basin are associated with major reservoirs including the Medina Lake System (66,750 acft/yr), Calaveras Lake (37,000 acft/yr), and Braunig Lake (12,000 acft/yr).

In the past, water quality in the San Antonio Basin varied from very good in the upper basin to relatively poor in the lower basin, particularly during periods of low flow. Since 1987, advanced water treatment has been instituted at the three major San Antonio area water recycling plants, Dos Rios, Leon Creek, and Salado Creek. As a result, dissolved oxygen concentrations in the San Antonio River have been maintained well above the State stream standard of 5.0 mg/L and aquatic life has been significantly enhanced. However, certain water quality concerns remain in the basin. Elevated bacteria levels have occurred in the lower San Antonio River, throughout Cibolo Creek, and in lower Leon Creek. Depressed dissolved oxygen levels have been observed in lower Leon Creek. Impaired fish and macro-benthic communities have been observed in Salado Creek. Finally, PCBs have been found in fish tissue in lower Leon Creek and a high priority has been assigned to initiating TMDL studies.

1.7.2.4 Guadalupe River Basin

The Guadalupe River Basin is bounded on the north by the Colorado River Basin, on the east by the Lavaca River Basin and the Lavaca-Guadalupe Coastal Basin, and on the west and south by the Nueces and San Antonio River Basins. The Guadalupe River rises in the west-central part of Kerr County. A spring-fed stream, it flows eastward through the Hill Country until it issues from the Balcones Escarpment near New Braunfels. It then crosses the Coastal Plain to

San Antonio Bay. Its total length is more than 430 river miles, and its drainage area is approximately 10,128 square miles above the Lower Guadalupe Saltwater Barrier and Diversion Dam, of which about 4,180 square miles are located within the San Antonio River Basin. Its principal tributaries are the San Marcos River, another spring fed stream, which joins the Guadalupe River in Gonzales County; the San Antonio River, which joins it just above its mouth on San Antonio Bay; and the Comal River, which joins it at New Braunfels. Comal Springs are the source of the Comal River, which flows about 2.5 miles before joining the Guadalupe River. Major population centers located in the basin include the cities of Victoria (Victoria County), San Marcos (Hays County), New Braunfels (Comal County), Seguin (Guadalupe County), Lockhart (Caldwell County), Cuero (DeWitt County), Gonzales (Gonzales County), and Luling (Caldwell County). Major reservoirs in the Guadalupe River Basin include Canyon Reservoir with authorized diversions averaging 90,000 acft/yr and Coletto Creek Reservoir with authorized diversions from the Guadalupe River of up to 20,000 acft/yr (excluding supplemental supplies from Canyon Reservoir). In addition, there are groups of run-of-river water rights having significant authorized annual consumptive uses. These rights are held by the GBRA (175,501 acft/yr), INVISTA/DuPont (33,000 acft/yr), and the City of Victoria (20,000 acft/yr).

The Guadalupe River Basin is characterized by generally high water quality throughout. Low dissolved oxygen concentrations have been observed in Peach, Elm, and Sandies Creeks. Elevated levels of bacteria have occurred in Sandies, Geronimo, Plum, and Peach Creeks. In addition, mercury was detected in edible fish tissue from Canyon Reservoir, however, additional data and information are needed before a TMDL may be scheduled.

1.7.2.5 Lower Colorado River Basin

Only a small portion of Kendall and Caldwell Counties is located in that part of the Lower Colorado River Basin located inside the planning region. The total drainage area of the Colorado River Basin is 41,763 square miles, of which only 76 square miles are located in the planning region. The only surface water presently available to these two areas of the South Central Texas Region is from local stock tanks.

1.7.2.6 Lavaca River Basin

Small portions of DeWitt, Gonzales, and Victoria Counties are located in that part of the Lavaca River Basin inside the planning region. The total drainage area of the Lavaca River Basin

is 2,309 square miles, of which 156 square miles are located in the planning region. The Lavaca-Navidad River Authority owns and operates Lake Texana and has contracts to provide 32,000 acft/yr of water to customers in the Colorado-Lavaca Coastal Basin, 41,840 acft/yr to Corpus Christi in the Nueces-Rio Grande Coastal Basin, and 594 acft/yr for use in the Lavaca-Guadalupe Coastal Basin.

1.7.2.7 Coastal Basins

Parts of the Colorado-Lavaca, Lavaca-Guadalupe, and San Antonio-Nueces Coastal Basins are located within the South Central Texas Region. None of these coastal basins has large surface water projects. Because of limited surface water availability from local runoff and groundwater quality considerations, these basins generally rely on adjoining river basins to provide surface water to meet their needs. The Colorado-Lavaca Coastal Basin obtains 32,000 acft/yr of surface water from Lake Texana in the Lavaca River Basin. The Lavaca-Guadalupe Coastal Basin obtains approximately 69,000 acft/yr of imported surface water, the majority of which is supplied from the Guadalupe River. The San Antonio-Nueces Coastal Basin obtains approximately 26,000 acft/yr of imported surface water supplied from the Nueces River Basin.

The TCEQ routinely monitors the Victoria Barge Canal segment in the Lavaca-Guadalupe Coastal Basin, which has no known water quality problems. All water quality standards and uses are supported, although phosphorus and chlorophyll-a levels are occasionally elevated. At certain times during the year, the canal is very biologically productive, but other parameters do not indicate water quality instability. According to the TCEQ, water quality in the Mission and Aransas River tidal segments, located in the San Antonio-Nueces Coastal Basin, may experience elevated bacteria levels, but the rivers otherwise have good water quality.

1.7.3 Major Springs

According to selected references,^{17,18} there are six major springs located within the planning area (Comal, San Marcos, Hueco, Leona, San Antonio, and San Pedro Springs).

- **Comal Springs:** Comal Springs is located in Landa Park, New Braunfels in Comal County. Comal Springs discharges water from the Edwards and associated limestones of the Edwards Aquifer and issues through the Comal Springs Fault. Senate Bill 3

¹⁷ TWDB, "Major and Historical Springs of Texas (Report #189)," March 1975.

¹⁸ Brune, Gunnar, "Springs of Texas," Volume I, Branch-Smith, Inc., Fort Worth, Texas, 1981.

limits the quantity of water that can be withdrawn from the Edwards Aquifer in each calendar year for the period beginning January 1, 2008 to no more than 572,000 acft. Senate Bill 3 specifies that the Edwards Aquifer Authority shall implement and enforce water management practices, procedures, and methods to ensure that not later than December 31, 2012, the continuous minimum spring flows of Comal and San Marcos Springs are maintained to protect endangered and threatened species to the extent required by federal law. Senate Bill 3 also specifies critical period management stages, triggers, and associated withdrawal reductions with the provision that, after January 1, 2013, the Authority may not require permitted withdrawals to be less than an annualized rate of 320,000 acft unless necessary for the protection of listed threatened or endangered species to the extent required by federal law. Long-term average discharge from Comal Springs is about 290 cfs.

- **San Marcos Springs:** San Marcos Springs is located 2 miles northeast of San Marcos, in Hays County. San Marcos Springs discharges water from the Edwards and associated limestones of the Edwards Aquifer and issues through the San Marcos Springs Fault. Senate Bill 3, as described in the Comal Springs text above, also applies to San Marcos Springs. Long-term average discharge from San Marcos Springs is about 176 cfs.
- **Hueco Springs:** Hueco Springs is located about 3 miles north of New Braunfels near the confluence of Elm Creek and the Guadalupe River in Comal County. There are two main springs issuing from a fault in the Edwards limestone at this location. Sources of water for these springs include the Edwards Aquifer and, possibly, underflow from the Guadalupe River. Long-term average discharge from Hueco Springs is about 40 cfs.
- **Leona Springs:** Leona Springs consists of three groups of springs located from 1 to 6 miles southeast of Uvalde, in Uvalde County. These springs discharge water from the Edwards Aquifer. Long-term average discharge from Leona Springs is about 25 cfs.
- **San Antonio Springs:** San Antonio Springs is located just above East Hildebrand Street in San Antonio, in Bexar County. San Antonio Springs discharge water from the Edwards Aquifer. Long-term average discharge from San Antonio Springs is about 20 cfs.
- **San Pedro Springs:** San Pedro Springs is located in San Pedro Park, San Antonio in Bexar County. San Pedro Springs discharges water from the Edwards Aquifer. Long-term average discharge from San Pedro Springs is about 5 cfs.

Since present levels of withdrawals from the Edwards Aquifer are greater than the withdrawal rates necessary to ensure continuous minimum discharges at Comal and San Marcos Springs, it may be necessary to either limit future withdrawals during drought or to increase recharge to the aquifer in sufficient quantities to protect endangered species and meet the future needs of those who depend upon it for their water supplies. Therefore, actions to limit withdrawals from the Edwards Aquifer and/or to supplement supplies from the aquifer, directly affect water supplies of the South Central Texas Region. To the extent that critical period

pumping restrictions are imposed to limit withdrawals to those specified by Senate Bill 3 in order to maintain flows at Comal and San Marcos Springs at levels sufficient to protect endangered and threatened species to the extent required by federal law, then those that now obtain water from the Edwards Aquifer will be required to obtain water from other sources to meet a part of their present needs and provide for growth.

1.8 Threats to Agricultural and Natural Resources

Pursuant to 31 TAC 357.7(a)(1)(L), the South Central Texas Regional Water Planning Group (SCTRWPG) identified the following threats to agriculture in the South Central Texas Regional Water Planning Area:

- A shortage of economically accessible fresh water of suitable quantity and quality for irrigation and for livestock drinking and sanitation purposes. For example, such a shortage could result from groundwater production at insufficiently sustainable rates and/or lack of control over groundwater production.
- Deterioration of water quality, such that the quantities available are not usable for irrigation or livestock drinking and sanitation. Increased salinity is an example of a water quality threat to agriculture.

The SCTRWPG identified the following threats to natural resources in the planning region:

- Reductions of quantity and/or quality of fresh water available to fish and wildlife.
- Changes to aquatic and riparian habitats associated with use of water from streams and aquifers.
- Temporary or permanent inundation of aquatic, riparian, and terrestrial habitats associated with surface water impoundment.

Technical evaluations of water management strategies (Section 4C, Volume II) and/or assessments of the cumulative effects of plan implementation (Section 7, Volume I) include quantitative and/or qualitative discussion of how identified threats to agriculture or natural resources are expected to be addressed or affected by a water management strategy and/or the plan. Following is a summary of specific quantitative and/or qualitative measures used to meet this requirement:

- Application of Groundwater Availability Models (GAMs) to illustrate projected changes in regional aquifer levels, spring discharges, and surface water/groundwater interactions during the planning period.
- Comparison of the Gross Business Effects (as provided by the TWDB) associated with failure to meet projected agricultural water needs with the costs of potential water management strategies available to the region.

- Applications of Surface Water Availability Models (WAMs) to quantify projected changes in streamflow and/or freshwater inflows to bays and estuaries. Graphical and tabular summaries of projected changes focus on time series data, monthly medians, and/or frequency of occurrence.
- Qualitative assessment of potential changes in groundwater or surface water quality based on available information.
- Acreage temporarily or permanently inundated by a planned reservoir and the frequency of such inundation.

1.9 Summary of Existing Plans

1.9.1 2007 State Water Plan¹⁹

In Section 26.051 of the Texas Water Code, the Executive Administrator of the TWDB is charged with producing a State Water Plan that addresses the broad public interest of the State. As currently specified in Sections 16.055 and 16.056, the Plan is to be periodically reviewed and updated and serve as a flexible guide to state policy for the development of its water resources. The TCEQ shall consider the State Water Plan in its water regulatory actions, although its actions are not bound by the Plan.

The 2007 Texas Water Plan provides a statewide perspective that places local and regional needs within the state context. Available individual and county-level studies were built into the overall findings, and in formulating water supply solutions, the Plan focused on economic viability while taking environmental sensitivity into consideration. Legislation, passed in the 75th Legislature, specifies a 5-year update period for the Plan that is based on regional planning studies, and provides that related financial assistance applications must be consistent with the regional and State plans for regulatory approval by State agencies.

The ultimate goal of the State Water Plan is to identify those policies and actions that may be needed to meet Texas' near- and long-term water needs, based on a reasonable projected use of water, affordable water supply availability, and the goal of conservation of the State's natural resources.

The 2007 State Water Plan includes water management strategies for the South Central Texas Region that could produce new supplies of as much as 732,779 acft in 2060. These strategies include (1) water conservation; (2) water reuse; (3) purchase/lease and transfer of

¹⁹ TWDB, *State Water Plan: Water for Texas – 2007*, Austin, Texas, 2007.

irrigation rights for municipal use; (4) aquifer storage and recovery; (5) increased use of Canyon Reservoir; (6) Lower Guadalupe River diversions (including 19,000 acft of off-channel storage); (7) Colorado River diversion; (8) brackish groundwater desalination; (9) desalination of seawater; (10) recharge of the Edwards aquifer; (11) enhanced use of the Carrizo Aquifer from Wilson, Gonzales, and Bastrop Counties; and (12) expansion of existing well fields.

1.9.2 2006 Regional Water Plan

The 2006 South Central Texas Regional Water Plan was adopted in January 2006. However, because the SCT Regional Water Plan was not adopted until after the statutory deadline, the SCT Regional Water Plan was not formally approved by the TWDB until 2009 pursuant to an amendment process established by House Bill 3776 of the 80th Texas Legislature. The SCT Regional Water Plan, outlines the water management strategies recommended by the planning group to meet the identified needs in the region. These water management strategies are listed in Appendix 2.1 of the 2007 State Water Plan.

1.9.3 Local Water Plans

During this planning process the South Central Texas Planning Group worked with each local entity to develop a water management plan to meet any identified needs. These plans are contained in Section 4 of this document.

1.9.4 Current Preparations for Drought

Under requirements of Senate Bill 1, 1997 Texas Legislature, drought contingency plans are required by the TCEQ for wholesale water suppliers, irrigation districts, and retail water suppliers. Senate Bill 1 also requires that TCEQ require surface water right holders that supply 1,000 acft or more of water for non-irrigation use and 10,000 acft/yr for irrigation use prepare a water conservation plan. In addition, conservation plans are commonly included in the management plans of groundwater conservation districts.

All drought contingency plans are required to set triggering criteria for initiation and termination of drought response stages and contain supply and demand management measures to be implemented during each stage. The retail and wholesale water suppliers' plans contain measures to limit or restrict the use of water for purposes such as the irrigation of landscaped

areas, to wash any motor vehicle, to fill or add water to any indoor or outdoor swimming pool, operation of any ornamental fountain, and the irrigation of golf course greens, tees, and fairways.

The groundwater conservation district management plans also contain conservation plans that set goals and objectives for conserving groundwater within the district. The districts use methods such as requiring wells in areas that are in danger of over producing groundwater and damaging the aquifers to restrict production by means of production permits, metering the amount of water produced, and by working with water utilities, agricultural, and industrial users within the district to promote the efficient use of water.

SAWS' Water Conservation and Reuse Plan aims to reduce the impacts of drought in the San Antonio area of the South Central Texas Region by water conservation programs for its customers. One of the goals of this plan is to increase the public's awareness of water-saving methods, in order to encourage customers to voluntarily conserve water, thus reducing Edwards Aquifer use. Reuse of treated municipal wastewater for landscape irrigation is also a part of the SAWS Conservation and Reuse Plan designed to reduce the use of potable groundwater for non-potable applications. A major goal of this part of the plan is to virtually eliminate the use of groundwater for irrigation and stream augmentation while preserving the integrity of the Edwards Aquifer.

Senate Bill 3 of the 80th Texas Legislature established Critical Period management provisions to address Edwards Aquifer usage during times of drought. These provisions apply to all holders of regular permits, the customers of all permittees who are retail water utilities, and owners of exempt wells. Under these provisions, during times of drought, water use restrictions are placed into effect, as appropriate and necessary.

The South Central Texas Regional Water Plan relies upon local water management agencies and water utilities drought contingency plans to identify factors specific to each source of water supply to be considered in determining whether to initiate a drought response, and actions to be taken as part of the response. Section 6.2 includes additional information and recommendations of the SCTRWPG regarding drought management.

1.10 Water Loss Audits

In accordance with 31 TAC 357.7(a)(1)(M), the South Central Texas 2011 Regional Water Plan includes water loss information below that was compiled by the TWDB from water loss audits performed by retail public utilities of the South Central Texas Regional Water

Planning Area pursuant to §358.6 of this title (relating to Water Loss Audits). In addition, in accordance with 31 TAC 357.7(a)(7)(A)(iv), the regional water planning group has considered strategies to address issues identified in the information compiled by the TWDB from the water loss audits performed by retail public utilities pursuant to §358.6 of this title (relating to Water Loss Audits).

The 2005 Water Loss Data presented herein were submitted to the Texas Water Development Board (TWDB) by water utilities in Texas as required by HB 3338 of the 78th Texas Legislature. HB 3338 required the TWDB to compile the information included in the water audits by type of retail public utility and by regional water planning area, and provide that information to the regional planning groups for use in identifying appropriate water management strategies in the development of their regional water plan. The water loss data presented below were acquired as part of the 2005 Water Loss Audit reporting requirements. The methodology used relies upon self-reporting data provided by public utilities, and due to this, the self-reported data discussed in the TWDB Water Loss Report indicates that some of the data may be suspect and in need of further refinement.²⁰

The TWDB provided the list of 119 public utilities of the South Central Texas Water Planning Region that filed a water loss audit report, including the reported information for each of the following 27 factors: (1) population served, (2) quantity of water delivered, (3) percent of master meter accuracy, (4) quantity of water billed and metered, (5) quantity of water billed and unmetered, (6) quantity of water unbilled and metered, (7) quantity of water unbilled and unmetered, (8) total quantity of authorized consumption, (9) percent of customer meter accuracy, (10) quantity of customer meter accuracy loss, (11) quantity of unauthorized consumption, (12) quantity of apparent loss, (13) quantity of main line leaks, (14) quantity of customer line leaks, (15) quantity of storage tank overflows, (16) quantity of real loss, (17) quantity of total loss, (18) quantity of total water loss plus authorized consumption, (19) number of service connections, (20) number of miles of main lines, (21) number of connections per mile of mail lines, (22) quantity of loss per mile of mail lines, (23) quantity of loss per connection, (24) production water cost, (25) dollar value of real loss, (26) retail water cost, and (27) dollar value of apparent loss. On December 15, 2009, staff of TWDB informed the Technical

²⁰ Alan Plummer Associates, Inc. and Water Prospecting and Resource Consulting, LLC, "An Analysis of Water Loss, as Reported by Water Suppliers in Texas," Texas Water Development Board, Austin, Texas, January, 2007.

Consultants that the TWDB “methodology used in calculating percentage water loss for water systems that receive TWDB loans is as follows: (Balancing Error + Total Water Loss) divided by (Corrected input volume) equals Percentage Water Loss.” Data for each of the factors presented in the previous sentence (Balancing Error, Total Water Loss, and Corrected input volume) were included in the data provided by the TWDB, and are shown in Table 1-11. In Table 1-11, Corrected input volume is “Water Produced” and “Water Loss” is the sum of Balancing Error and Total Water Loss.

The cut off point the TWDB uses for inclusion of a water utility as a Water User Group (WUG) member for which population projections and water demand projections are made for regional planning is 280 acft of deliveries during the first year of the planning period, which in the present case is 2000. Of the 119 public utilities that responded to the water loss survey, 68 reported having delivered less than 280 acft in 2005, and 51 reported having delivered more than 280 acft in 2005.

The 119 water utilities that responded to the water loss survey, reported having served 1,982,769 people (about 87 percent of the 2005 estimated regional population) in 2005 (Table 1-11). Total reported quantity of water produced was 305,030 acre-feet, with a reported quantity of water loss of 28,856 acre-feet (Table 1-11). The quantity of water loss, as a percent of estimated total water originating at the source is calculated at about 9.5 percent (Table 1-11).

Of the 49 utilities that produced more than 280 acft/yr reporting with complete data, 4 (8 percent) reported water loss greater than 30 percent and a total of 11 (22 percent) reported losses greater than 20 percent (Table 1-11). For those utilities having water loss rates greater than about 10 percent, leak detection and repair, one of the leading water conservation measures, should be used to locate and repair leaks, thereby reducing the quantities of additional water needed. There were about 60 percent of the utilities (68 utilities) reporting water losses in the 2005 water loss survey that have water loss rates greater than 10 percent. For all utilities and especially those with water loss rates in excess of 10 percent, it is recommended that leak detection be pursued for the purpose of locating and evaluating leaks and providing information for determining if leak repair is a viable water conservation measure to pursue. However, as explained by the TWDB, the self-reported data from the water loss audits appears to be somewhat unreliable, therefore it may be unsuitable as a basis for recommendations concerning specific water management strategies for specific water user groups. It is hoped that future water loss audit

information will improve in accuracy and be more useful as a basis for specific water management strategy recommendations for water user groups.

Table 1-11.
Water Loss Audit – 2005
South Central Texas Water Planning Region

No.	Utility Name	Population Served	Water Produced (acft)	Water Loss (acft)	Percent Loss (%)	Per Capita Use (gpcd)
Utilities with Deliveries Less Than 280 acft						
1	BERRY OAKS WATER CO	72	16.04	5.28	32.96	199
2	BexarMet Water District-HEB/Bulverde	30	13.49	1.24	9.20	401
3	BIGFOOT WSC	375	39.44	0.01	0.02	94
4	BMWD BULVERDE HILLS	933	176.44	73.48	41.64	169
5	BMWD CANYON PARK ESTATES	303	61.70	9.89	16.03	182
6	BMWD CHAPARRAL	1,389	201.72	56.89	28.20	130
7	BMWD COUNTRY OAKS ESTATES	357	22.38	2.15	9.60	56
8	BMWD ELM VALLEY PARK	693	146.13	39.36	26.93	188
9	BMWD GERONIMO FOREST WATER SYSTEM	471	87.09	24.98	28.69	165
10	BMWD HIDDEN SPRINGS	81	22.91	0.22	0.98	253
11	BMWD LEON SPRINGS MOBILE VILLA	717	61.39	10.53	17.15	76
12	BMWD MEADOWOOD ACRES WSC	744	85.77	9.34	10.89	103
13	BMWD MOBILE CITY ESTATES	153	14.04	1.49	10.61	82
14	BMWD NORTH SAN ANTONIO HILLS	540	135.61	32.07	23.65	224
15	BMWD OAKLAND ESTATES	465	53.97	6.98	12.94	104
16	BMWD VILLAGE GREEN	825	201.40	16.90	8.39	218
17	BMWD WEST VIEW SUBDIVISION	417	33.62	4.43	13.16	72
18	BMWD WOODS OF SPRING BRANCH	90	10.35	3.16	30.53	103
19	CALHOUN COUNTY RURAL WATER SYSTEM	2,718	256.83	12.36	4.81	84
20	CEDAR OAK MESA WSC	500	34.40	1.65	4.80	61
21	CITY OF AUSTWELL	366	21.02	1.02	4.85	51
22	CITY OF CHARLOTTE	1,637	251.04	Not reported		137
23	CITY OF FALLS CITY	600	112.14	16.14	14.39	167
24	CITY OF LA VERNIA	1,250	263.29	30.77	11.69	188
25	CITY OF MARION	1,890	234.06	22.67	9.68	111
26	CITY OF POINT COMFORT	781	154.16	-1.54	-1.00	176
27	CITY OF RUNGE	4,563	206.34	53.32	25.84	40
28	CITY OF SMILEY	462	99.47	7.27	7.31	192
29	CITY OF WOODSBORO	1,685	273.73	73.03	26.68	145
30	CLEAR WATER ESTATES	459	140.26	0.80	0.57	273
31	CREEKWOOD RANCHES WSC	450	37.55	2.69	7.17	74
32	DEER CREEK WATER CO	720	48.17	5.48	11.37	60
33	DERBY WSC	51	7.58	2.36	31.16	133
34	ENCINAL WSC	819	185.62	15.77	8.50	202
35	FOWLERTON WSC	75	11.41	0.44	3.90	136
36	FRIO CIELO RANCH ASSO WATER SYSTEM	40	13.15	0.03	0.19	293
37	HANCOCK OAK HILLS SUBDIVISION	123	13.50	6.14	45.50	98
38	HIGHWAY 90 RANCH WSC	300	41.40	6.94	16.76	123
39	HIGHWAY 117 WSC	180	33.36	0.03	0.10	165

Table 1-11 (Continued)

No.	Utility Name	Population Served	Water Produced (acft)	Water Loss (acft)	Percent Loss (%)	Per Capita Use (gpcd)
40	KINGS POINT WSC	45	36.61	Not reported		NA
41	KNIPPA WSC	750	145.00	29.00	20.00	173
42	LAKE MCQUEENEY ESTATES	756	62.73	9.18	14.64	74
43	LAKE VALLEY RANCH	258	36.66	5.36	14.61	127
44	LSR WSC	44	4.60	-0.12	-2.54	93
45	MCPAHAN WSC	953	92.10	22.30	24.21	86
46	MEDINA COUNTY WCID 2	700	167.59	78.57	46.88	214
47	MOSS WOODS SUBDIVISION WATER SYSTEM	117	10.46	1.55	14.85	80
48	NEW ALSACE WATER CO INC	175	34.62	0.00	0.00	177
49	OAK COUNTRY PROPERTY OWNERS ASSN	60	8.52	0.00	-0.03	127
50	OAK FOREST WATER SYSTEM	306	35.29	2.76	7.82	103
51	PICOSA WSC	1,896	141.64	19.19	13.55	67
52	PLATTEN CREEK WATER SYSTEM	88	7.10	0.37	5.19	72
53	RADIANCE WSC	85	7.05	0.44	6.28	74
54	RANDOLPH PROPERTIES	690	55.47	Not reported		72
55	REAL WSC	13	16.35	14.58	89.17	NA
56	REBECCA CREEK MUD	1,170	134.82	26.25	19.47	103
57	REFUGIO COUNTY WCID 1	495	67.99	13.42	19.74	123
58	ROCKY CREEK SUBDIVISION WATER SYSTEM	83	7.63	0.13	1.66	82
59	SADDLERIDGE SUBDIVISION	189	27.10	0.05	0.19	128
60	SEVEN OAKS WATER SUPPLY	112	8.61	-0.05	-0.60	69
61	SPRING BRANCH INDIAN HILLS ESTATES	153	38.95	2.39	6.13	227
62	STAPLES FARMERS CORP	648	67.96	10.30	15.16	94
63	THE OAKS WSC	1,152	272.75	29.18	10.70	211
64	UTOPIA WSC	500	67.90	14.73	21.69	121
65	VICTORIA COUNTY WCID 2	750	65.77	15.03	22.86	78
66	VILLE DALSACE WSC	200	35.00	0.00	0.00	156
67	WEST MEDINA WSC	915	229.55	29.60	12.90	224
68	WESTHAVEN ASSOCIATION INC	280	69.97	37.13	53.07	223
Subtotal Utilities with Less Than 280 acft/yr		41,907	5,777.77	917.10	15.87	123
Utilities with Deliveries More Than 280 acft						
69	ATASCOSA RURAL WSC	10,150	1,076.66	42.59	3.96	95
70	BEXAR COUNTY WCID 10 WINDCREST	5,105	1,132.10	50.55	4.46	198
71	BMWD CASTLE HILLS	7,998	1,953.95	167.87	8.59	218
72	BMWD HILL COUNTRY	35,061	9,711.48	718.25	7.40	247
73	BMWD NORTH WEST	36,000	4,394.54	450.26	10.25	109
74	BMWD NORTHEAST	41,226	6,401.64	152.47	2.38	139
75	BMWD TEXAS RESEARCH PARK	114	322.89	98.73	30.58	NA
76	BMWD SOUTHSIDE	101,766	15,543.02	2,816.86	18.12	136
77	BMWD TIMBERWOOD PARK	10,017	2,088.00	502.43	24.06	186
78	CIMARRON PARK WATER CO INC	2,043	330.51	24.97	7.56	144
79	CITY OF ALAMO HEIGHTS	7,319	2,118.36	502.55	23.72	258

Table 1-11 (Concluded)

No.	Utility Name	Population Served	Water Produced (acft)	Water Loss (acft)	Percent Loss (%)	Per Capita Use (gpcd)
80	CITY OF BOERNE	8,900	1,712.56	213.47	12.46	172
81	CITY OF CASTROVILLE	3,500	680.38	143.03	21.02	174
82	CITY OF CIBOLO	8,500	859.91	32.41	3.77	90
83	CITY OF CONVERSE	11,508	1,661.22	262.92	15.83	129
84	CITY OF CUERO	6,571	1,888.44	688.73	36.47	257
85	CITY OF DEVINE	4,140	793.04	12.45	1.57	171
86	CITY OF DILLEY	3,697	647.76	215.69	33.30	156
87	CITY OF GOLIAD	2,018	358.19	22.84	6.38	158
88	CITY OF GONZALES	7,802	2,290.08	803.39	35.08	262
89	CITY OF HONDO	8,481	1,904.69	436.05	22.89	200
90	CITY OF KARNES CITY	3,457	376.51	Not reported		97
91	CITY OF KIRBY	8,673	902.79	135.68	15.03	93
92	CITY OF KYLE	18,500	2,105.04	311.36	14.79	102
93	CITY OF LIVE OAK	7,000	1,255.16	149.02	11.87	160
94	CITY OF NIXON	2,036	817.60	24.23	2.96	358
95	CITY OF PEARSALL	7,257	1,656.79	137.75	8.31	204
96	CITY OF PORT LAVACA	12,000	1,498.25	230.72	15.40	111
97	CITY OF REFUGIO	2,941	604.55	133.38	22.06	184
98	CITY OF SAN MARCOS	49,307	6,228.61	883.64	14.19	113
99	CITY OF SCHERTZ	26,780	3,770.62	169.65	4.50	126
100	CITY OF SHAVANO PARK	1,754	781.16	102.48	13.12	398
101	CITY OF STOCKDALE	2,015	488.38	Not reported		216
102	CITY OF UNIVERSAL CITY	14,849	2,551.51	167.43	6.56	153
103	CITY OF UVALDE	16,233	3,770.85	653.36	17.33	207
104	CITY OF VICTORIA	61,703	10,493.86	1,348.15	12.85	152
105	CITY OF YOAKUM	5,731	1,013.04	110.33	10.89	158
106	EAST MEDINA COUNTY SUD UNIT 1	8,600	767.66	166.64	21.71	80
107	EL OSO WSC	4,242	717.85	190.24	26.50	151
108	FAIR OAKS RANCH UTILITIES	5,602	1,456.17	131.79	9.05	232
109	GONZALES COUNTY WSC	6,555	1,396.28	233.52	16.72	190
110	GREEN VALLEY SUD	27,741	2,860.25	464.79	16.25	92
111	KENDALL COUNTY WCID 1	2,301	306.14	46.08	15.05	119
112	MAXWELL WSC	5,145	383.90	41.73	10.87	67
113	NEW BRAUNFELS UTILITIES	50,805	10,544.86	1,710.35	16.22	185
114	OAK HILLS WSC	4,000	550.16	2.37	0.43	123
115	PORT OCONNOR MUD	3,759	295.50	27.30	9.24	70
116	S S WSC	11,475	1,585.98	41.39	2.61	123
117	SAN ANTONIO WATER SYSTEM	1,239,399	181,035.57	11,797.59	6.52	130
118	SUNKO WSC	3,486	514.48	89.80	17.45	132
119	WIMBERLEY WSC	5,600	652.82	79.78	12.22	104
Subtotal Utilities with More than 280 acft/yr		1,940,862	299,252	27,939	9.34	138
TOTAL		1,982,769	305,030	28,856	9.46	137