1 Description of the South Central Texas Region
[31 TAC §357.30]

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 six minor aquifers (Queen City, Sparta, Austin Chalk, Buda Limestone, Leona Gravel, 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 42 percent of the total water used in the South Central Texas Region in 2010. Water demands for the counties using significant supplies from the Edwards Aquifer are projected to grow at a rate of approximately 0.76 percent per year between 2020 and 2040. However, not even the present level of use can be sustained through drought periods 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 (Coleto 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 Climate[1]

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.

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.

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 4.7 feet per year in the southwestern portion of the region to a low of 2.5 feet in the eastern portion of the region.

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

Table 1-1. South Central Texas Region – Lost 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						
Karnes		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.

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

River Basin	Precipitation			Temperature					Annual Net Reservoir Surface Evaporation (inches)
					Mean Daily Minimum		Mean Daily Maximum		
	Mean Annual (inches)	Wettest Month(s)	Driest Month(s)	Mean Annual (°F)	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.

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 Geology[2]

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

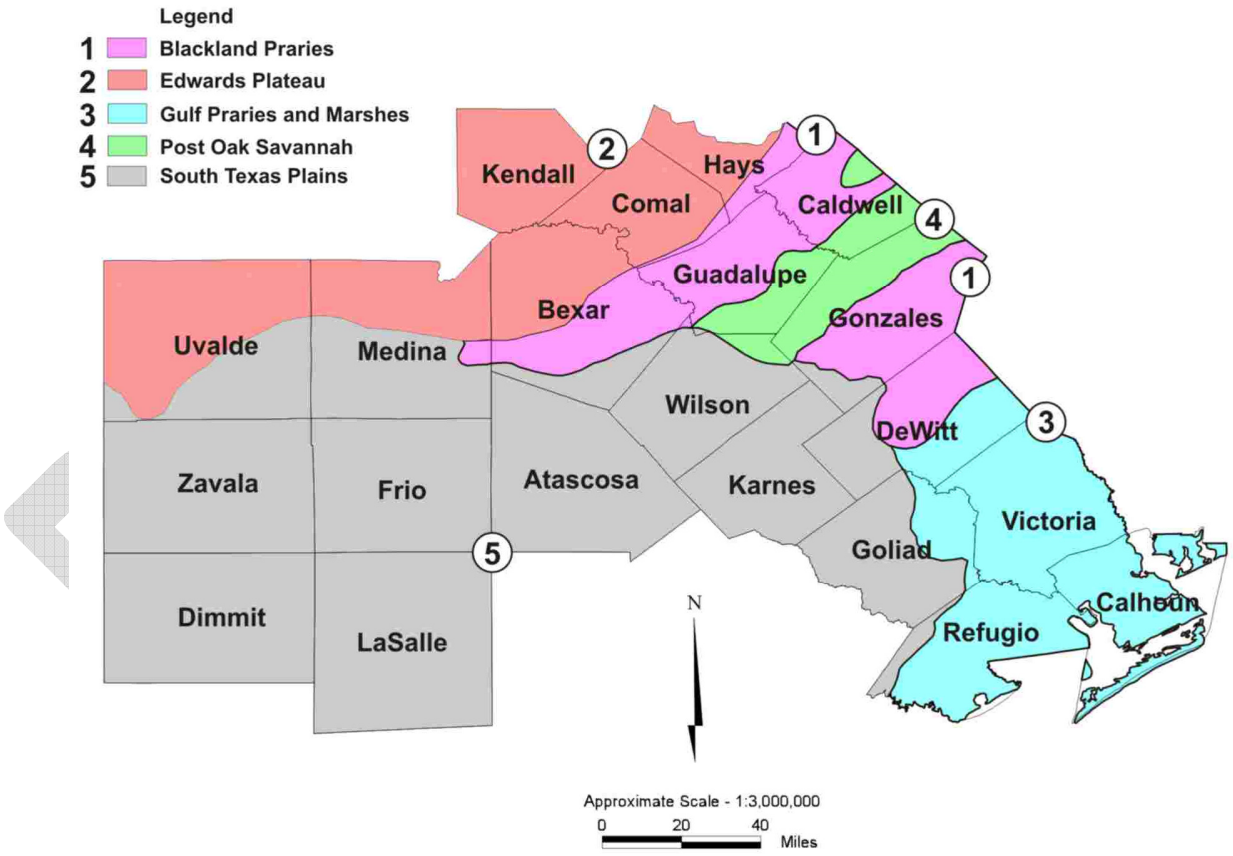
2 TWDB, Op. Cit., May 1977.

Beaumont Formation overlie the Lissie Formation. Throughout the region, alluvial sediments of Recent Age occur along streams and coastal areas.

1.2.3 Vegetational Areas[3]

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.

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-

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.

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 illinoinensis*), 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 gramas 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 six minor aquifers (Queen City, Sparta, Austin Chalk, Buda Limestone, Leona Gravel, and Yegua-Jackson). Details about these water resources are presented in Chapters 1.7 and 3.

Springs are also significant water resources in the South Central Texas Region. The two most noteworthy springs are the Comal and San Marcos Springs, which both emanate from the Edwards Aquifer and 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, are 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 groundwater withdrawals and 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. Typical species of the coastal plains streams include gar, minnows, topminnows, sunfishes, bass, catfish, and a few species of darters and suckers. Although strongly dependent on the physical habitat factors present, typical species Edwards Plateau streams 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 G with notations concerning their habitat preferences and protected status, if any.

Table 1-3. Agricultural Resources — 2012 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	1,987	665,287	335	108,097	47,358	26,658
Bexar	798,080	2,457	342,882	140	89,092	50,580	8,271
Caldwell	349,440	1,623	310,433	191	55,928	41,074	633
Calhoun	327,680	264	184,094	697	60,536	51,280	5,795
Comal	359,680	1,104	205,018	186	14,070	6,946	422
De Witt	581,760	1,711	536,411	314	49,680	36,120	618
Dimmit	851,840	367	677,023	1,845	44,329	6,839	4,794
Frio	725,120	651	713,262	1,096	152,921	83,205	60,494
Goliad	546,560	1,175	494,930	421	32,990	23,566	744
Gonzales	683,520	1,674	609,790	364	68,954	49,443	7,817
Guadalupe	455,040	2,241	383,109	171	112,126	87,090	1,941
Hays (part)[1]	239,360	720	122,503	170	15,158	7,604	516
Karnes	480,000	1,288	464,641	361	82,701	49,674	905
Kendall	424,320	1,387	369,951	267	27,527	10,459	912
LaSalle	952,960	446	634,847	1,423	44,049	19,437	7,018
Medina	849,920	1,976	833,587	422	141,396	103,912	51,418
Refugio	492,800	259	474,709	1,833	86,511	79,336	1,235
Uvalde	996,480	640	977,281	1,527	139,831	84,546	49,531
Victoria	565,120	1,533	437,805	286	80,151	62,400	3,315
Wilson	516,480	2,444	439,689	180	103,263	71,403	12,437
Zavala	831,360	287	692,850	2,414	95,980	35,313	29,384
Total	**12,816,000**	**26,234**	**10,570,102**	**403**	**1,605,290**	**1,007,585**	**274,858**

[1]Estimate for that portion of Hays County located in the planning region (50%).
Source: 2012 Census of Agriculture, Vol. 1 Geographic Area Series, "Table 1: County Summary Highlights — 2012."

1.2.4.3 Agricultural Resources

Of the 12.8 million acres of land area in the planning region, over 10.57 million acres (83 percent) are classified as farmland and ranchland (Table 1-3). In 2012, there were 26,234 farms and ranches in the region with an average size of 403 acres. Of the 10.57 million acres of farmland, over 1.60 million acres were classified as cropland, of which about 1.01 million acres were harvested in 2012. Approximately 17 percent

(274,858 acres) of the total cropland in the region was reported to be irrigated in 2012[4]. The leading irrigation counties are located in the western part of the region and include Frio, Medina, Uvalde, Zavala, and Atascosa. The sum of irrigated acres in these five counties increased by 22.0 percent between 2007 and 2012. In Medina and Uvalde Counties, which rely primarily on the Edwards Aquifer, irrigated acres increased by 24.8 and 9.2 percent, respectively, between 2007 and 2012. 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 Chapters 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 1,014,752 in 1960 to 2,535,451 in 2010, an increase of 1,520,699 or 2.5 times (Table 1-4). The largest percentage increase occurred between the years 2000 and 2010 (24.2 percent), while the smallest occurred between 1960 and 1970 (16.2 percent). During the period 1960 to 2010, 16 counties had a positive annual growth rate, while five counties (DeWitt, Dimmit, Karnes, Refugio, and Zavala) had a negative annual growth rate. Historically, the fastest growing counties in the region were Hays (4.22 percent), Kendall (3.53 percent), Comal (3.46 percent), and Guadalupe (3.07 percent), while the slowest growing counties were Gonzales (0.21 percent), LaSalle (0.29 percent), Calhoun (0.51 percent), and Goliad (0.57 percent). Chapter 2.1 summarizes population projections through the year 2070 for the South Central Texas Region.

4 2012 Census of Agriculture, Volume 1 Geographic Area Series, "Table 1. County Summary Highlights: 2012."

Table 1-4. Population Growth — 1960 to 2010 South Central Texas Region

County	Year						Growth Rate[1] (%)
	1960	1970	1980	1990	2000	2010	
Atascosa	18,828	18,696	25,055	30,533	38,628	44,911	1.75
Bexar	687,151	830,460	988,800	1,185,394	1,392,931	1,714,773	1.85
Caldwell	17,222	21,178	23,637	26,392	32,194	38,066	1.60
Calhoun	16,592	17,831	19,574	19,053	20,647	21,381	0.51
Comal	19,844	24,165	36,446	51,832	78,021	108,472	3.46
DeWitt	20,683	18,660	18,903	18,840	20,013	20,097	-0.06
Dimmit	10,095	9,039	11,367	10,433	10,248	9,996	-0.02
Frio	10,112	11,159	13,785	13,472	16,252	17,217	1.07
Goliad	5,429	4,869	5,193	5,980	6,928	7,210	0.57
Gonzales	17,845	16,375	16,883	17,205	18,628	19,807	0.21
Guadalupe	29,017	33,554	46,708	64,873	89,023	131,533	3.07
Hays (part)[2]	15,947	22,114	32,475	52,491	72,499	125,686	4.22
Karnes	14,995	13,462	13,593	12,455	15,446	14,824	-0.02
Kendall	5,889	6,964	10,635	14,589	23,743	33,410	3.53
LaSalle	5,972	5,014	5,514	5,254	5,866	6,886	0.29
Medina	18,904	20,249	23,164	27,312	39,304	46,006	1.79
Refugio	10,975	9,494	9,289	7,976	7,828	7,383	-0.79
Uvalde	16,814	17,348	22,441	23,340	25,926	26,405	0.91
Victoria	46,475	53,766	68,807	74,361	84,088	86,793	1.26
Wilson	13,267	13,041	16,756	22,650	32,408	42,918	2.38
Zavala	12,696	11,370	11,666	12,162	11,600	11,677	-0.17
Total	**1,014,752**	**1,178,808**	**1,420,691**	**1,696,597**	**2,042,221**	**2,535,451**	**1.85**

[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 1960, 1970, 1980, 1990, 2000, and 2010, U.S. Department of Commerce.

There are 119 cities or other water supply entities (excluding County-Other) in the South Central Texas Region for which the TWDB has made population and water demand projections. Of the 119 cities and entities, 52 have a projected population in 2020 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 16 entities having a projected 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 projected population by 2020.

1.3.2 Demographic Characteristics

In 2010, 83 percent of the South Central Texas Region population resided in urban areas, while only 17 percent resided in rural areas (Figure 1-2). LaSalle County had the lowest population in 2010, with 6,886 residents (averaging 4.6 persons per square mile), while Bexar County had the highest population in the region with 1,714,773 residents (averaging 1,375 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 20 years of age (29.8 percent) and from 25 to 34 years of age (13.8 percent) (Figure 1-3). The age groups with the lowest percentage of the population are ages 20 to 24 (7.7 percent) and ages 55 to 64 (10.7 percent) (Figure 1-3).

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	Live Oak	Bexar	Hill Country
Atascosa Rural WSC	Bexar	Hill Country	Lockhart	Caldwell	Hill Country
Benton City WSC	Atascosa	Winter Garden	Luling	Caldwell	Hill Country
Boerne	Kendall	Hill Country	Maxwell WSC	Caldwell	Hill Country
Bulverde	Comal	Hill Country	McCoy WSC	Atascosa	Winter Garden
Canyon Lake WSC	Comal	Hill Country	New Braunfels	Comal	Hill Country
Carrizo Springs	Dimmit	Winter Garden	Oak Hills WSC	Wilson	Winter Garden
Cibolo	Guadalupe	Hill Country	Pearsall	Frio	Winter Garden
Converse	Bexar	Hill Country	Pleasanton	Atascosa	Winter Garden
Crystal City	Zavala	Winter Garden	Plum Creek WC	Hays	Hill Country
Crystal Clear WSC	Guadalupe	Hill Country	Polonia WSC	Caldwell	Hill Country
Cuero	DeWitt	Coastal	Port Lavaca	Calhoun	Coastal
East Central SUD	Bexar	Hill Country	SS WSC	Wilson	Winter Garden
East Medina County SUD	Medina	Hill Country	San Antonio	Bexar	Hill Country
Fair Oaks Ranch	Bexar	Hill Country	San Antonio Water System	Bexar	Hill Country
Floresville	Wilson	Winter Garden	San Marcos	Hays	Hill Country
Goforth SUD	Hays	Hill Country	Schertz	Guadalupe	Hill Country
Gonzales	Gonzales	Coastal	Seguin	Guadalupe	Hill Country
Gonzales County WSC	Gonzales	Coastal	Selma	Bexar	Hill Country
Green Valley SUD	Guadalupe	Hill Country	Springs Hill WSC	Guadalupe	Hill Country
Helotes	Bexar	Hill Country	Terrell Hills	Bexar	Hill Country
Hondo	Medina	Hill Country	Universal City	Bexar	Hill Country
Kirby	Bexar	Hill Country	Uvalde	Uvalde	Winter Garden
Kyle	Hays	Hill Country	Victoria	Victoria	Coastal
Lackland AFB	Bexar	Hill Country	Windcrest	Bexar	Hill Country
Leon Valley	Bexar	Hill Country	Yancey WSC	Medina	Winter Garden

* Entities with a projected population of 5,000 or more in 2020.

Figure 1-2. Percentages of Population Residing in Urban and Rural Areas (2010) South Central Texas Region

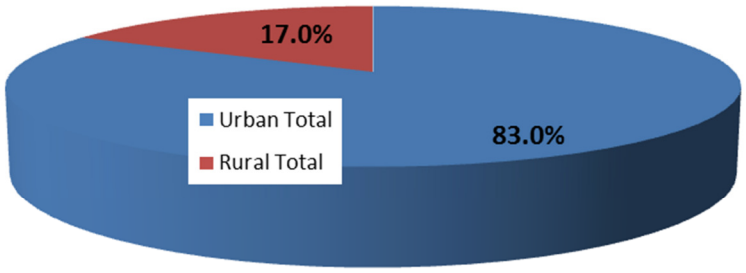
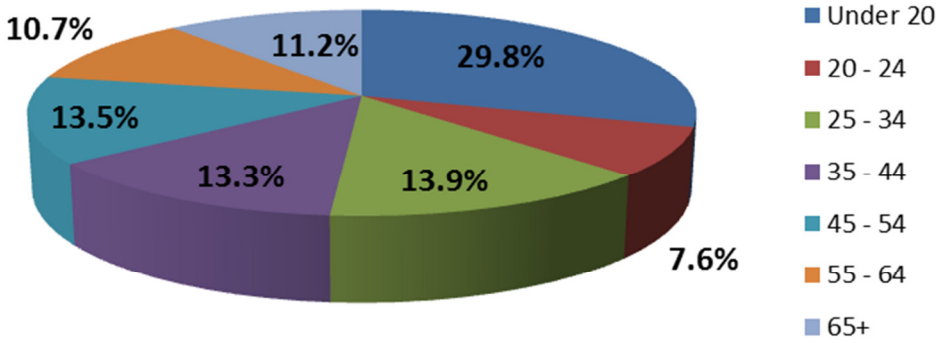


Table 1-6. County Population and Area South Central Texas Region

County	*Population (2010)*	*Area (sq. mi.)*	*Population Density*	*County*	*Population (2010)*	*Area (sq. mi.)*	*Population Density*
Atascosa	44,911	1,232	36.5	Hays (part)	125,686	374	336.1
Bexar	1,714,773	1,247	1,375.1	Karnes	14,824	750	19.8
Caldwell	38,066	546	69.7	Kendall	33,410	663	50.4
Calhoun	21,381	512	41.8	LaSalle	6,886	1,489	4.6
Comal	108,472	562	193.0	Medina	46,006	1,328	34.6
DeWitt	20,097	909	22.1	Refugio	7,383	770	9.6
Dimmit	9,996	1,331	7.5	Uvalde	26,405	1,557	17.0
Frio	17,217	1,133	15.2	Victoria	86,793	883	98.3
Goliad	7,210	854	8.4	Wilson	42,918	807	53.2
Gonzales	19,807	1,068	18.5	Zavala	11,677	1,299	9.0
Guadalupe	131,533	711	185.0	Total	2,535,451	20,025	126.6
Source: U.S. Census Bureau, U.S. Department of Commerce.							

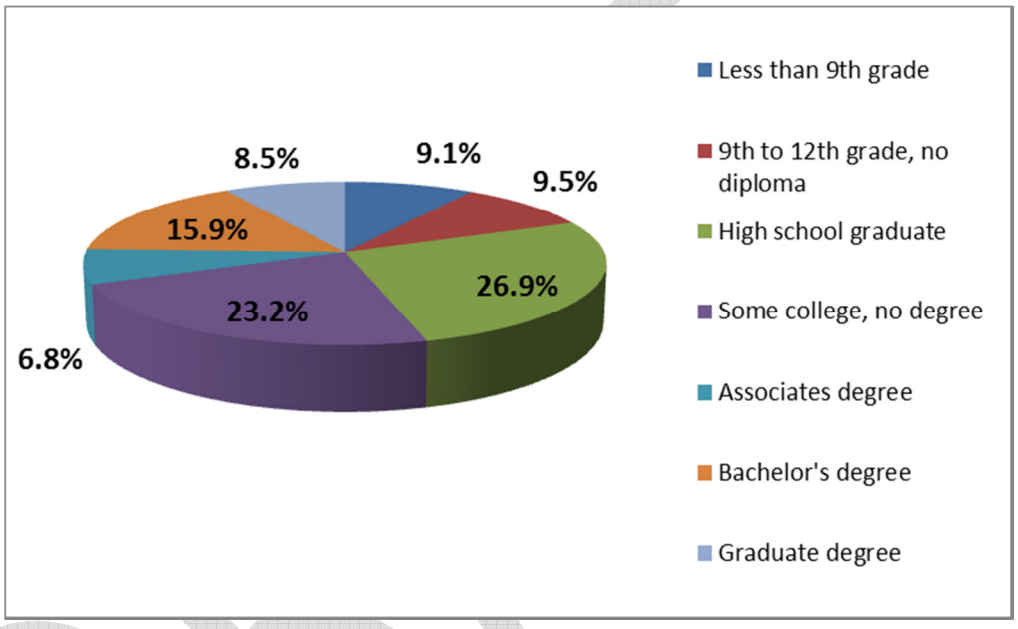
Figure 1-3. Age Distribution of the Population (2010) South Central Texas Region



Source : 2010 U.S. Census Data

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, 81.3 percent have at least a high school diploma, while 18.7 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 (26.9 percent) and those who have completed some college education, but have no degree (23.2 percent). Only 8.5 percent of the population who are 25 years or older have a graduate degree (Figure 1-4).

Figure 1-4. Level of Educational Achievement (2010) South Central Texas Region



1.4 Economy — Major Sectors and Industries

1.4.1 Summary of the South Central Texas Regional Economy

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 have experienced solid growth in recent years. Table 1-7 provides a county-by-county summary of economic activity in the key sectors most significantly affecting the economy of the South Central Texas Region. A strong trades and services sector, including a thriving tourism industry in San Antonio, comprises about 48 percent of regional economic activity summarized in Table 1-7. Fabricated metal products, industrial machinery, petrochemicals, and food processing form the core of the manufacturing sector, which accounts for approximately 27 percent of regional economic activity. 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. The agricultural sector, including both livestock and crops, accounts for about 3 percent of regional economic activity. Finally, oil and gas production dominate the mining sector of the economy and, together, represent about 22 percent of the regional economic activity summarized in Table 1-7. Additional information regarding

the agricultural, livestock, mining, manufacturing, and trades and services sectors is presented in the following sections.

Table 1-7. Summary of Economic Activity South Central Texas Region

County	Trades & Services Economic Activity (million dollars)[1]	Manufacturing Economic Activity (million dollars)[1]	Market Value of All Livestock (million dollars)[2]	Market Value of All Crops (million dollars)[2]	Value of Oil Production (million dollars)[3]	Value of Gas Production (million dollars)[4]	Total (million dollars)
Atascosa	$464	$0	$57	$28	$709	$25	**$1,283**
Bexar	$18,346	$12,305	$18	$55	$11	$0	**$30,735**
Caldwell	$353	$90	$52	$11	$165	$1	**$672**
Calhoun	$343	(D)	$14	$28	$15	$12	**$412**
Comal	$2,685	$1,094	$6	(D)	$0	$0	**$3,784**
DeWitt	$205	$110	$54	$8	$1,614	$475	**$2,466**
Dimmit	$83	$0	$27	$9	$1,206	$295	**$1,619**
Frio	$146	$0	$75	$109	$337	$20	**$687**
Goliad	$41	$0	$16	$4	$25	$42	**$127**
Gonzales	$287	$445	$495	$23	$2,253	$74	**$3,575**
Guadalupe	$1,965	$2,154	$31	$30	$94	$0	**$4,274**
Hays (part)[5]	$1,849	$974	$4	$4	$0	$0	**$2,830**
Karnes	$151	$0	$17	$11	$3,774	$325	**$4,277**
Kendall	$1,149	$181	$10	$2	$2,061	$353	**$3,757**
LaSalle	$85	$0	$7	$12	$0	$0	**$104**
Medina	$580	$75	$51	$65	$0	$0	**$771**
Refugio	$80	$0	$10	$33	$310	$41	**$475**
Uvalde	$483	$204	$51	$62	$0	$0	**$799**
Victoria	$2,216	(D)	$20	$28	$50	$17	**$2,331**
Wilson	$250	$0	$74	$28	$244	$3	**$600**
Zavala	$38	$0	$44	$29	$291	$5	**$407**
Total	**$31,798**	**$17,631**	**$1,129**	**$577**	**$13,159**	**$1,687**	**$65,982**

1. Source: 2007 Economic Census, U.S. Department of Commerce.
2. Source: 2012 Census of Agriculture, Volume 1 Geographic Area Series, "Table 1. County Summary Highlights: 2012."
3. Determined by using the number of barrels produced as reported to the Texas Railroad Commission times $94.05/bbl (the average price for 2010).
4. Determined by using the mcf produced as reported to the Texas Railroad Commission times $2.65/mcf (the average price for 2010).
5. Estimated that 70% of economic activity within Hays County takes place within the planning region.

1.4.2 Agricultural Production

It is estimated that over 1.6 million acres in the South Central Texas Region were used in crop production in 2012. Of this total, only 274,858 acres (17.1 percent) were irrigated while the remaining 82.9 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 Frio, Medina, Uvalde, Zavala, and Atascosa.

According to the 2012 Census of Agriculture, all crops grown in the South Central Texas Region had a market value of over $577 million in 2012. The leading agricultural producing counties in the region, by market value of products, are Frio, Medina, Uvalde, Bexar, and Refugio. The major crops grown in the region include corn, grain sorghum, wheat, soybeans, and cotton (Livestock Production

According to the 2012 Census of Agriculture, livestock marketed in the South Central Texas region had a value of over $1.1 billion, or about 1.9 times the value of all crop production (Table 1-7). 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 97 percent of

these types of chickens within the region. Table 1-9 provides a county-by-county summary of livestock production. In 2012, the leading livestock producing counties in the region by market value were Gonzales, Frio, and Wilson Counties (Table 1-7).

Table 1-8).

Corn and grain sorghum have historically been the leading crops in the region. In 2012, it was estimated that over 16 million bushels of corn were harvested in the South Central Texas Region. The leading corn producing counties in the region are Medina, Uvalde, Frio, and Victoria (Livestock Production

According to the 2012 Census of Agriculture, livestock marketed in the South Central Texas region had a value of over $1.1 billion, or about 1.9 times the value of all crop production (Table 1-7). 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 97 percent of these types of chickens within the region. Table 1-9 provides a county-by-county summary of livestock production. In 2012, the leading livestock producing counties in the region by market value were Gonzales, Frio, and Wilson Counties (Table 1-7).

Table 1-8). Grain sorghum also contributes significantly to the agricultural sector. In 2012, it was estimated that over 10 million bushels of grain sorghum were harvested in the region. The leading grain sorghum producing counties in the region are Refugio, Calhoun, Victoria, and Guadalupe (Livestock Production

According to the 2012 Census of Agriculture, livestock marketed in the South Central Texas region had a value of over $1.1 billion, or about 1.9 times the value of all crop production (Table 1-7). 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 97 percent of these types of chickens within the region. Table 1-9 provides a county-by-county summary of livestock production. In 2012, the leading livestock producing counties in the region by market value were Gonzales, Frio, and Wilson Counties (Table 1-7).

Table 1-8). 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 3.5 million bushels of wheat harvested in 2012. The leading wheat producing counties in the region are Uvalde, Frio, Medina, and Guadalupe (Livestock Production

According to the 2012 Census of Agriculture, livestock marketed in the South Central Texas region had a value of over $1.1 billion, or about 1.9 times the value of all crop production (Table 1-7). 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 97 percent of these types of chickens within the region. Table 1-9 provides a county-by-county summary of livestock production. In 2012, the leading livestock producing counties in the region by market value were Gonzales, Frio, and Wilson Counties (Table 1-7).

Table 1-8).

Because of favorable climatic and soil conditions, the coastal counties of Calhoun and Victoria are able to produce rice. In 2012, these two counties combined produced over 244,000 hundredweight (cwt) of rice (Livestock Production

According to the 2012 Census of Agriculture, livestock marketed in the South Central Texas region had a value of over $1.1 billion, or about 1.9 times the value of all crop production (Table 1-7). 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 97 percent of these types of chickens within the region. Table 1-9 provides a county-by-county summary of livestock production. In 2012, the leading livestock producing counties in the region by market value were Gonzales, Frio, and Wilson Counties (Table 1-7).

Table 1-8). Cotton production is widespread throughout the region. In 2012, the 19 counties in which cotton is produced combined to harvest over 229,000 bales. (Livestock Production

According to the 2012 Census of Agriculture, livestock marketed in the South Central Texas region had a value of over $1.1 billion, or about 1.9 times the value of all crop production (Table 1-7). 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 97 percent of these types of chickens within the region. Table 1-9 provides a county-by-county summary of livestock production. In 2012, the leading livestock producing counties in the region by market value were Gonzales, Frio, and Wilson Counties (Table 1-7).

Table 1-8). Leading counties for cotton production were Medina, Refugio, and Uvalde.

Soybean production in the region reportedly occurs in 8 counties, but total production and leading counties are uncertain due to data withheld to avoid disclosure of production by individual producers.

1.4.3 Livestock Production

According to the 2012 Census of Agriculture, livestock marketed in the South Central Texas region had a value of over $1.1 billion, or about 1.9 times the value of all crop production (Table 1-7). 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 97 percent of these types of chickens within the region. Table 1-9 provides a county-by-county summary of livestock production. In 2012, the leading livestock producing counties in the region by market value were Gonzales, Frio, and Wilson Counties (Table 1-7).

Table 1-8. Summary of Farm Production Data – 2012 South Central Texas Region

County	Selected Crops Harvested						
	Corn (bushels)	Grain Sorghum (bushels)	Wheat (bushels)	Rice (100 lbs)	Cotton (bales)	Soybeans (bushels)	Hay, Alfalfa, Other (tons)
Atascosa	245,467	130,084	97,986	0	7,832	0	58,129
Bexar	560,423	196,090	272,033	0	2,279	5,048	52,825
Caldwell	324,561	373,036	77,210	0	6,944	0	36,301
Calhoun	1,080,956	1,705,194	0	244,331	21,945	(D)	7,953
Comal	10,938	(D)	(D)	0	0	(D)	12,046
DeWitt	364,501	36,952	9,707	0	338	(D)	53,171
Dimmit	(D)	47,231	61,230	0	2,334	0	1,500
Frio	1,963,896	262,777	691,404	0	9,553	0	22,832
Goliad	176,014	99,876	0	0	1,015	0	23,273
Gonzales	383,321	141,554	20,572	0	(D)	0	68,437
Guadalupe	1,178,629	1,146,854	554,946	0	6,181	0	58,801
Hays (part)[1]	102,311	31,741	51,526	0	(D)	0	5,316
Karnes	456,655	280,867	58,341	0	7,610	0	40,100
Kendall	0	0	5,724	0	0	0	12,813
LaSalle	218,000	189,478	61,754	0	(D)	0	5,138
Medina	3,174,626	423,194	638,557	0	44,249	(D)	54,610
Refugio	446,321	2,702,320	(D)	0	42,856	2,580	10,810
Uvalde	2,564,466	679,626	751,572	0	42,186	(D)	28,865
Victoria	1,455,015	1,325,277	(D)	(D)	18,819	(D)	40,132
Wilson	943,030	447,069	222,437	0	3,064	0	91,344
Zavala	579,481	315,100	274,370	0	12,521	0	9,315
Total	**16,228,611+(D)**	**10,534,320+(D)**	**3,849,369+(D)**	**244,331+(D)**	**229,726+(D)**	**7,628+(D)**	**693,711**

- [1]Estimate for that portion of Hays County located in the planning region (50%).
- (D) – Withheld to avoid disclosing data for individual producers.

Table 1-9. Summary of Livestock Production Data — 2012 South Central Texas Region

County	Livestock and Poultry						
	Cattle & Calves (Number)	*Beef Cattle (Number)*	*Milk Cows (Number)*	*Hogs & Pigs (Number)*	*Sheep & Lambs (Number)*	*Layers & Pullets (Number)*	*Broilers (Number)*
Atascosa	73,016	(D)	(D)	283	1,308	2,562	(D)
Bexar	31,309	(D)	(D)	1,566	3,601	4,382	1,688
Caldwell	35,524	(D)	(D)	554	1,283	(D)	2,224,698
Calhoun	14,729	9,769	0	(D)	404	1,656	(D)
Comal	11,312	7,219	0	312	3,278	9,571	3,883
DeWitt	83,556	53,023	0	328	811	(D)	925
Dimmit	16,596	(D)	(D)	(D)	358	717	30
Frio	50,587	18,947	180	154	299	332	(D)
Goliad	40,230	(D)	(D)	212	394	1,242	315
Gonzales	114,100	63,976	0	464	762	5,262,354	86,673,265
Guadalupe	41,264	25,886	126	1,673	2,661	39,941	(D)
Hays (part)[1]	7,426	4,448	0	95	825	2,069	37
Karnes	43,003	29,932	0	165	311	670	0
Kendall	13,812	(D)	(D)	444	9,773	5,903	378
LaSalle	18,821	12,405	0	70	464	139	0
Medina	44,069	(D)	(D)	991	2,805	3,397	(D)
Refugio	20,637	(D)	(D)	75	(D)	269	0
Uvalde	43,084	17,778	8	24	6,935	1,031	(D)
Victoria	48,765	34,194	55	460	484	1,721	16
Wilson	76,972	(D)	(D)	637	1,424	3,736	(D)
Zavala	38,767	(D)	(D)	44	169	330	0
Total	**867,579**	**277,577+(D)**	**369+(D)**	**8,551+(D)**	**38,349+(D)**	**5,342,022+(D)**	**88,905,235+(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: 2012 Census of Agriculture, Volume 1 Geographic Area Series, "Table 1. County Summary Highlights: 2012."

1.4.4 Mining

The South Central Texas Region has 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 five counties (Comal, Hays, La Salle, Medina, and Uvalde) in the region

had economic activity derived from oil and gas production in 2012. Oil and gas production in the remaining 16 counties generated over $14.5 billion in 2012. The leading oil and gas producing counties in the region were Karnes, Gonzales, Kendall, DeWitt, and Dimmit (Table 1-7).

1.4.5 Manufacturing[5]

In 2007, manufacturing facilities contributed over $17.5 billion in sales in the South Central Texas Region (Table 1-7).[6] The leading manufacturing counties in the region for which data are disclosed, by value of shipments, are Bexar, Guadalupe, Comal, and Hays. Significant economic activity associated with manufacturing also occurs in Calhoun and Victoria Counties, though data is withheld to avoid disclosures for individual producers. Types of manufacturing plants and products in the region include plastics; nylon intermediates; automobiles; printing and related support activities; fabricated metal products; miscellaneous products; and food products.

1.4.6 Trades and Services[7]

In 2007, wholesale trade, retail trade, and services contributed over $31.5 billion in sales or receipts in the South Central Texas Region (Table 1-7).[8] The leading trades and services counties, by value of sales or receipts, in the region are Bexar, Comal, Victoria, Guadalupe, and Hays.

1.5 Water Uses[9]

Water use in 2012 within the South Central Texas Region as reported to or estimated by the TWDB is summarized by source for each of the use types in

5 Source: 2007 Economic Census, U.S. Department of Commerce.

6 Data for 2007 are the most recent data available.

7 Source: 2007 Economic Census, U.S. Department of Commerce.

8 Data for 2007 are the most recent data available.

9 Data provided by the TWDB.

Table 1-10.

In 2012, total water use in the region was estimated to be 981,165 acft/yr. Municipal use accounted for 407,564 acft (or 41.5%) and irrigation use accounted for 370,626 acft (or 37.8%) of the total water use within the region. Surface water use totaled 230,403 acft (23.5%) and groundwater use made up the remaining 750,762 acft (76.5%) (

Table 1-10). Surface water is the primary source for manufacturing and steam-electric power generation uses and groundwater is the primary source for other use types.

Table 1-10. Summary of Water Use – 2012 (acft/yr) South Central Texas Region

Use Type	*Total Use (2012)*	*% of Total*	*Use by Source*		*% by Source*	
			Surface Water	*Ground-water*	*Surface Water*	*Ground-water*
Municipal	407,564	41.5%	66,036	341,528	16.2%	83.8%
Manufacturing	67,514	6.9%	54,062	13,452	80.1%	19.9%
Mining	46,245	4.7%	2,805	43,440	6.1%	93.9%
Steam-Electric	66,587	6.8%	55,530	11,057	83.4%	16.6%
Irrigation	370,626	37.8%	43,093	327,533	11.6%	88.4%
Livestock	22,629	2.3%	8,877	13,752	39.2%	60.8%
Total	**981,165**	**100.0%**	**230,403**	**750,762**	**23.5%**	**76.5%**

1.6 Wholesale Water Providers

The TWDB defines a Wholesale Water Provider (WWP) as 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 most recent regional water plan. Under this definition, the list of WWPs for the South Central Texas Region includes:

- San Antonio Water System (SAWS);
- Guadalupe-Blanco River Authority (GBRA);
- Canyon Region Water Authority (CRWA);
- Schertz-Sequin Local Government Corporation (SSLGC); and
- Springs Hill WSC (SHWSC).

In addition, the recently-formed Texas Water Alliance (TWA), the Cibolo Valley Local Government Corporation (CVLGC), and the Hays-Caldwell Public Utility Agency (HCPUA) are included as WWPs because they are 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 Chapter 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, the Medina Lake System, and direct reuse. SAWS serves more than 1.3 million people in the urbanized portion of Bexar County. SAWS provides part or all of the water supplies for fourteen utility systems, retail water supplies for most, but not all, of the City of San Antonio, and a portion of the industrial supplies in Bexar County. SAWS is the sole water provider for the Cities of Balcones Heights, Castle Hills, China Grove, Elmendorf, Hill County Village, Hollywood Park, Olmos Park, Somerset, and Terrell Hills, and provides part of the water supply for Helotes, Leon Valley, Live Oak, East Central WSC, and Atascosa Rural WSC.

1.6.2 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 in the lower basin 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 developing transmission and treatment facilities to deliver these supplies to customers.

1.6.3 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 11 water supply corporations, cities, and districts responsible for acquiring, treating, and transporting potable water (Chapter 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.

1.6.4 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, 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, SSLGC sells water to Selma, Universal City, Converse, Springs Hill WSC, and SAWS (Chapter 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.

1.6.5 Springs Hill WSC

Springs Hill Water Supply Corporation (WSC) is a retail and wholesale water supplier serving customers located primarily in Guadalupe County. Springs Hill WSC provides retail water service within the WSC's service area as well as wholesale water to Crystal Clear WSC. A portion of the Springs Hill WSC service area is located inside the City of Seguin. In addition, a portion of the service area is also included in the projected demands for Guadalupe County-Other.

1.6.6 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 WWPs and water user groups (WUGs) most likely located in the South Central Texas Regional Water Planning Area (Region L). To date, several WWPs and WUGs have shown measures of interest in groundwater supplies potentially available from northeast Gonzales County. Although TWA has obtained groundwater production permits from the Gonzales County Underground Water Conservation District, it is uncertain at this time which one or more of these entities will enter into water supply agreements with the TWA.

1.6.7 Hays-Caldwell Public Utility Agency

The Hays-Caldwell Public Utility Agency (HCPUA) was formed by the Canyon Regional Water Authority, Buda, Kyle, and San Marcos for the purposes of sharing water supplies and costs of infrastructure development. The HCPUA was created under Chapter 422 of the Local Government Code General Law in January 2007. Participants in the HCPUA, who are part owners based on an agreed percentage distribution, could take the role(s) of wholesale water distributors and/or retail water purveyors.

1.6.8 Cibolo Valley Local Government Corporation

The Cibolo Valley Local Government Corporation (CVLGC) is a partnership between the Cities of Cibolo and Schertz created to develop more groundwater supplies within the local area.

1.7 Water Resources and Quality Considerations

1.7.1 Groundwater[10]

There are five major and six 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) (Figure 1-5). The six minor aquifers are the Austin Chalk, Buda Limestone, Leona Gravel, Sparta, Queen City, and Yegua-Jackson. Each aquifer is described and a general assessment of water quality is provided in the following subsections. A summary of estimated groundwater supplies is presented in Chapter 3.

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

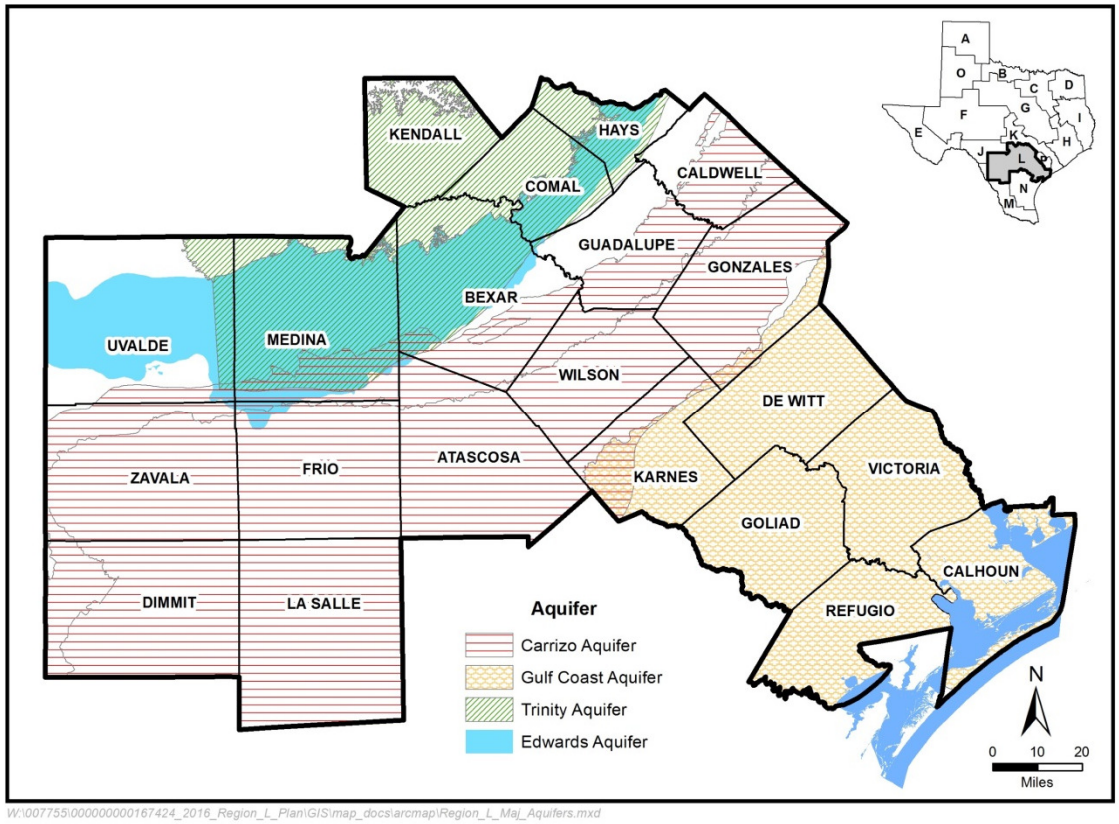
10 Data supplied by the Texas Water Development Board.

Edwards-Trinity (High Plains) Aquifers, however, in this document, it will be referred to as the Edwards Aquifer (Figure 1-5).

The aquifer consists primarily of partially dissolved limestone having high permeability. Aquifer thickness ranges from 200 to 600 feet, and freshwater saturated thickness averages 560 feet in the southern part of the aquifer. The groundwater, although hard, is generally fresh and contains less than 500 milligrams per liter of total dissolved solids. The aquifer feeds several well-known springs, including Comal Springs in Comal County, which is the largest spring in the State, and San Marcos Springs in Hays County, which is the second largest. Hueco, San Pedro, San Antonio, and Leona Springs also discharge from the aquifer. Because of its highly permeable nature, Edwards water levels and spring flows respond quickly to rainfall, drought, and pumping.

Water from the aquifer is primarily used for municipal, irrigation, industrial, and recreational purposes. San Antonio obtains most of its water supply from the Edwards Aquifer.

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



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 sometimes referred to in this plan as the Carrizo Aquifer. The Carrizo-Wilcox Aquifer is a major aquifer extending from the Louisiana border to the border of Mexico. The aquifer is composed of sand locally interbedded with gravel, silt, clay, and lignite. Although the Carrizo-Wilcox Aquifer

reaches 3,000 feet in thickness, the freshwater saturated thickness of the sands averages 670 feet. The groundwater, although hard, is generally fresh and typically contains less than 500 milligrams per liter of total dissolved solids in the outcrop, whereas softer groundwater with total dissolved solids of more than 1,000 milligrams per liter may occur in the confined zone. High iron and manganese content is excess of secondary drinking water standards is characteristic of the deeper, confined portions of the aquifer. Parts of the aquifer in the Winter Garden area are slightly to moderately saline, with total dissolved solids ranging from 1,000 to 7,000 milligrams per liter. Irrigation accounts for slightly more than half the water pumped, and pumping for municipal supply accounts for another 40 percent. Water levels have declined in the Winter Garden area because of irrigation pumping and in the northwestern part of the aquifer because of municipal pumping.

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 is composed of several smaller aquifers contained within the Trinity Group. Although referred to differently in different parts of the state, they include the Antlers, Glen Rose, Paluxy, Twin Mountains, Travis Peak, Hensell, and Hosston Aquifers. These aquifers consist of limestones, sands, clays, gravels, and conglomerates. Their combined freshwater saturated thickness averages about 600 feet in North Texas and about 1,900 feet in Central Texas. In general, groundwater is fresh but very hard in the outcrop of the aquifer. Total dissolved solids increase from less than 1,000 milligrams per liter in the east and southeast to between 1,000 and 5,000 milligrams per liter, or slightly to moderately saline, as depth to the aquifer increases. Sulfate and chloride concentrations also tend to increase with depth. The aquifer is one of the most extensive and highly used groundwater resources in Texas. Although its primary use is for municipalities, it is also used for irrigation, livestock, and domestic purposes.

1.7.1.4 Gulf Coast Aquifer

The Gulf Coast Aquifer is a major aquifer paralleling the Gulf of Mexico coastline from the Louisiana border to the border of Mexico. It consists of several aquifers, including the Jasper, Evangeline, and Chicot Aquifers, which are comprised of discontinuous sand, silt, clay, and gravel beds. The maximum total sand thickness of the Gulf Coast Aquifer ranges from 700 feet in the south to 1,300 feet in the north. Freshwater saturated thickness averages about 1,000 feet. Water quality varies with depth and locality: it is generally good in the central and northeastern parts of the aquifer, where the water contains less than 500 milligrams per liter of total dissolved solids, but declines to the south, where it typically contains 1,000 to more than 10,000 milligrams per liter of total dissolved solids and where the productivity of the aquifer decreases. High levels of radionuclides, thought to be naturally occurring, are found in some wells in Harris County in the outcrop and in South Texas. The aquifer is used from municipal, industrial, and irrigation purposes. In Harris, Galveston, Fort Bend, Jasper and Wharton counties, water level declines of as much as 350 feet have led to land subsidence.

1.7.1.5 Edwards-Trinity (Plateau) Aquifer

The Edwards-Trinity (Plateau) Aquifer is a major aquifer extending across much of the southwestern part of the State. The water-bearing units are composed predominantly of limestone and dolomite of the Edwards Group and sands of the Trinity Group. Although maximum saturated thickness of the aquifer is greater than 800 feet, freshwater saturated thickness averages 433 feet. Water quality ranges from fresh to slightly saline, with dissolved solids ranging from 100 to 3,000 milligrams per liter, and the water is generally characterized as hard within the Edwards Group. Water typically increases in salinity to the west within the Trinity Group. Springs occur along the northern, eastern, and southern margins of the aquifer, primarily near the bases of the Edwards and Trinity Groups where exposed at the surface. San Felipe Springs, near Del Rio, is the largest exposed spring along the southern margin. Of the groundwater pumped from this aquifer, more than two-thirds is used for irrigation, with the remainder used for municipal and livestock supplies. Water levels have remained relatively stable because recharge has generally kept pace with the relatively low amounts of pumping over the extent of the aquifer.

1.7.1.6 Sparta Aquifer

The Sparta Aquifer is a minor aquifer extending across East and South Texas, parallel to the Gulf of Mexico coastline and about 100 miles inland. Water is contained within a part of the Claiborne Group known as the Sparta Formation, a sand-rich units interbedded with silt and clay layers and with massive sand beds in the bottom section. The thickness of the formation changes gradually from more than 700 feet at the Sabine River to about 200 feet in South Texas. Freshwater saturated thickness averages about 120 feet. In outcrop areas and for a few miles in the subsurface, the water is usually fresh, with an average concentration of 300 milligrams per liter of total dissolved solids; however, water quality deteriorates with depth (below about 2,000 feet), where the groundwater has an average concentration of 800 milligrams per liter of total dissolved solids. Excess iron concentrations are common throughout the aquifer. Water from the aquifer is predominantly used for domestic and livestock purposes, and its quality has not been significantly affected by pumping. No significant water level declines have been detected throughout the aquifer in wells measured by the TWDB.

1.7.1.7 Queen City Aquifer

The Queen City Aquifer is a minor but widespread aquifer that stretches across the Texas upper coastal plain. Water is stored in the sand, loosely cemented sandstone, and interbedded clay layers of the Queen City Formation that reaches 2,000 feet in thickness in South Texas. Average freshwater saturation in the Queen City Aquifer is about 140 feet. Water is generally fresh, with an average concentration of total dissolved solids of about 300 milligrams per liter in the recharge zone and about 750 milligrams per liter deeper in the aquifer. Although salinity decreases from south to north, areas of excessive iron concentration and high acidity occur in the northeast. The aquifer is used primarily for livestock and domestic purposes, with significant municipal and industrial use in northeast Texas. Water levels have remained fairly stable over time in the northern part of the aquifer. Water level declines are more common in the central (10 to 70 feet) and southern (5 to 130 feet) parts of the aquifer.

1.7.1.8 Yegua-Jackson Aquifer

The Yegua-Jackson Aquifer is a minor aquifer stretching across the southeast part of the state. It includes water bearing parts of the Yegua Formation (part of the upper Claiborne Group) and the Jackson Group (comprising the Whitsett, Manning, Wellborn, and Caddell formations). These geologic units consist of interbedded sand, silt, and clay layers originally deposited as fluvial and deltaic sediments. Freshwater saturated thickness averages about 170 feet. Water quality varies greatly owning to sediment composition in the aquifer formations, and in all areas the aquifer becomes highly mineralized with depth. Most groundwater is produced from the sand units of the aquifer where the water is fresh and ranges from less than 50 to 1,000 milligrams per liter of total dissolved solids. Some slightly to moderately saline water, with concentrations of total dissolved solids ranging from 1,000 to 10,000 milligrams per liter, also occurs in the aquifer. No significant water level declines have occurred in wells measured by the TWDB. Groundwater for domestic and livestock purposes is available from shallow wells over most of the aquifer's extent. Water is also used for some municipal, industrial, and irrigation purposes.

1.7.1.9 Austin Chalk, Buda Limestone, and Leona Gravel Aquifers

The Austin Chalk and Buda Limestone are Upper Cretaceous in age. The Del Rio Clay provides a confining layer between the deeper Edwards Aquifer and shallower Buda Limestone, and the Eagle Ford Group separates the lower Buda and upper Austin Chalk formations. There are limited areas where the Buda Formation and the Austin Chalk Formation are at the right elevations and have sufficient hydraulic conductivity to produce significant quantities of water. Water quality in the Austin Chalk and Buda Limestone Formations are similar to the Edwards Aquifer and there is likely some interconnectivity between the aquifers. While most wells completed in this formations are for domestic or livestock use, there are some higher flowing municipal wells as well.

The Leona Formation includes alluvial aquifers adjacent to the Leona, Nueces, Frio, and other rivers in Central and South Texas. These alluvial aquifers generally depend on associated stream flow, springs, and recharge from adjacent aquifers, and are therefore subject to depletion during drought conditions. The majority of wells in this formation are small-flow domestic or livestock wells.

1.7.2 Surface Water

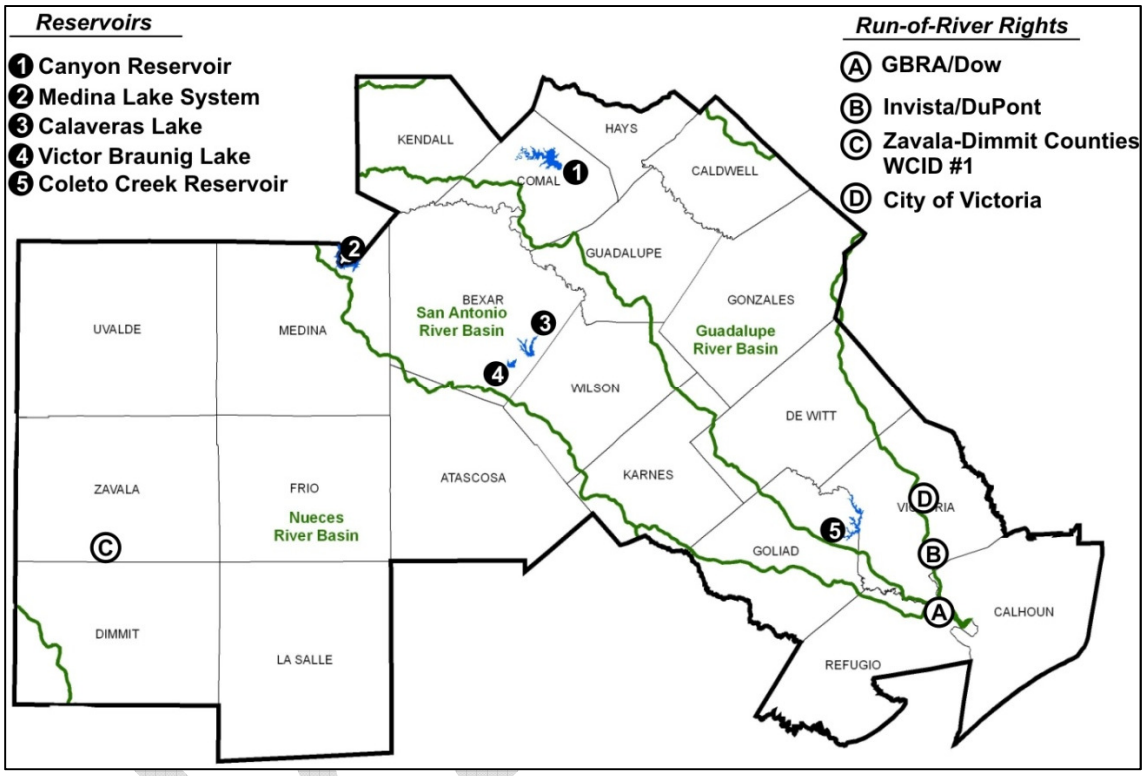
The South Central Texas Region includes parts of the Rio Grande, Nueces, San Antonio, Guadalupe, Colorado, and Lavaca River Basins and parts of the Colorado-Lavaca, Lavaca-Guadalupe, and San Antonio-Nueces Coastal Basins (Figure 1-6). Existing surface water supplies of the region include those derived 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. Existing surface water supplies available during drought are summarized in Chapter 3.

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.

Figure 1-6. Major River Basins, Reservoirs, and Run-of-River Rights



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.

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).

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 Coleto 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 and the Dow Chemical Company (175,501 acft/yr), INVISTA/DuPont (33,000 acft/yr), and the City of Victoria (27,007 acft/yr).

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 raw water to Formosa Plastics Corporation in the Colorado-Lavaca Coastal Basin and Corpus Christi in the Nueces-Rio Grande 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 surface water from Lake Texana in the Lavaca River Basin. The Lavaca-Guadalupe Coastal Basin obtains surface water imported from the Guadalupe River. The San Antonio-Nueces Coastal Basin obtains imported surface water supplied from the Nueces River Basin.

1.7.3 Major Springs

According to selected references,[11,12] 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 of the 80th Texas Legislature limited 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, specified critical period withdrawal reductions and triggers, and established the Edwards Aquifer Recovery Implementation Program (EARIP) for protection of species listed as threatened or endangered under federal law and associated with the aquifer. As a result of the EARIP, an Habitat Conservation Plan (EAHCP) was published in November 2012 and approved by the U.S. Fish & Wildlife Service in February 2013. Flow protection measures in the EAHCP seek to ensure a minimum monthly average discharge from Comal Springs in excess of 30 cfs in a repeat of the drought of record. 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 and the EAHCP, as described in the Comal Springs text above, also apply to San Marcos Springs. Flow protection measures in the EAHCP seek to ensure a minimum monthly average discharge from San Marcos Springs in excess of 60 cfs in a repeat of the drought of record. Long-term average discharge from San Marcos Springs is about 170 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

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

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

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.

1.7.4 Surface Water Quality

Surface water quality within the South Central Texas Region is generally good with typical values for criteria such as total dissolved solids (TDS), chlorides, sulfates, dissolved oxygen, pH, bacteria, and temperature in compliance with applicable Texas Surface Water Quality Standards. Within the South Central Texas Region, these standards are specified for 18 stream segments in the Guadalupe River Basin, 13 stream segments in the San Antonio River Basin, 12 stream segments in the Nueces River Basin, 2 stream segments in the San Antonio – Nueces Coastal Basin, and the Victoria Barge Canal in the Lavaca – Guadalupe Coastal Basin. With the exception of the Victoria Barge Canal, all of these segments support contact recreation and most support domestic water supply. Aquatic life uses are characterized as exceptional in 20 percent of these segments and high in an additional 70 percent of the segments.

Pursuant to Section 303(d) of the federal Clean Water Act, the most recent list of impaired water bodies for which effluent limitations are not stringent enough to implement water quality standards was issued in 2012. This list includes 28 inland water bodies intersecting the South Central Texas Region with 8, 12, 7, and 1 in the Guadalupe, San Antonio, Nueces, and Mission River systems (including tributary segments), respectively. Total Maximum Daily Loads (TMDLs) are being determined for 5 of these bodies, standards are under review for 7, and additional data is needed for 16. The most common impaired parameters are bacteria, dissolved oxygen, and fish community. In addition, Carancahua, Guadalupe, and Mission Bays are currently listed with bacteria as the impaired parameter because oysters occur in these waters.

Surface water quality characteristics typical of streams and bays in the South Central Texas Region are generally suitable for raw water uses in the industrial, steam-electric power generation, mining, irrigation, and livestock sectors as well as municipal and domestic potable uses after application of conventional treatment methods. Noted impaired water quality parameters in some water bodies does not preclude development of proximate or upstream water management strategies, but does point to the importance of appropriate wastewater treatment, management of non-point source pollutants, and compliance with environmental flow standards.

1.8 Threats to Agricultural and Natural Resources

Pursuant to 31 TAC 357.30, the South Central Texas Regional Water Planning Group (SCTRWPG) has 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 (Chapter 5) and/or assessments of the cumulative effects of plan implementation (Chapter 6) 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:

- Reliance upon TWDB application of Groundwater Availability Models (GAMs) to illustrate projected changes in regional aquifer levels (Desired Future Conditions) consistent with Modeled Available Groundwater (MAG) estimates, and portray spring discharges and surface water/groundwater interactions at the end of 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), along with the Flow Regime Application Tool (FRAT) (when necessary), for compliance with TCEQ Environmental Flow Standards in evaluation of proposed new appropriations and 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 2012 State Water Plan[13]

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 2012 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 effects 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 reasonable projected uses of water, affordable water supply availability, and the goal of conservation of the State's natural resources.

The 2012 State Water Plan includes water management strategies for the South Central Texas Region that could produce new supplies of as much as 765,738 acft in 2060. Selected water management strategies contained in the plan are summarized below:

Three Brackish Groundwater Desalination (Wilcox Aquifer) projects would provide a total of up to 42,220 acft/yr of water in the year 2060 with a capital cost of $378 million.

Hays/Caldwell Public Utility Agency Project would provide up to 33,314 acft/yr of groundwater (Carrizo Aquifer) in 2060 with a capital cost of $308 million.

Guadalupe-Blanco River Authority Mid-Basin Project would provide 25,000 acft/yr of Guadalupe run-of-river supplies stored in an off-channel reservoir starting in 2020 with a capital cost of $547 million.

Off-channel reservoir project (Lower Colorado River Authority/San Antonio Water System) would provide 90,000 acft/yr of water starting in 2030 with a capital cost of $2 billion.

Recycled Water Programs would provide up to 41,737 acft/yr of water in 2060 with a capita cost of $465 million.

Seawater Desalination Project would provide 84,012 acft/yr of water in 2060 with a capital cost of $1.3 billion.

13 TWDB, State Water Plan: Water for Texas – 2012, Austin, Texas, 2012.

Conservation strategies account for 11 percent of the total amount of water that would be provided by the region's recommended water management strategies.

1.9.2 2011 Regional Water Plan

The 2011 South Central Texas Regional Water Plan was adopted in January 2011. 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 A.2 of the 2012 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 reflected in Chapter 5 of this document.

1.9.4 Current Preparations for Drought

Under requirements of Senate Bill 1 of the 75th Texas Legislature, drought contingency plans are required by the TCEQ for wholesale water providers, irrigation districts, and retail water suppliers. Senate Bill 1 also specifies 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 courses.

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 water for non-potable applications.

Senate Bill 3 of the 80th Texas Legislature established critical period management provisions and the Edwards Aquifer Habitat Conservation Plan established flow

protection measures to address Edwards Aquifer management and springflow 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 and other flow protection measures are engaged, 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. Chapter 7 includes additional information and recommendations of the SCTRWPG regarding drought management.

1.10 Water Loss Audits

In accordance with 31 TAC 357.30, the South Central Texas 2016 Regional Water Plan includes water loss information 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 357.30, 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 2010 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 2010 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 may be suspect and in need of further refinement.

The TWDB provided the list of 115 public utilities of the South Central Texas Water Planning Region that filed a water loss audit report. Table 1-11 summarizes a portion of that data for each of the 115 entities. This table shows the total retail population served, total water volume input into the system, total water loss, percent loss, and the value of water loss in dollars.

The cutoff 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 2010. Of the 115 public utilities that responded to the water loss survey, 60 reported having delivered less than 280 acft in 2010, and 55 reported having delivered more than 280 acft in 2010.

The 115 water utilities that responded to the water loss survey, reported having served 2,198,808 people in 2010 (about 87 percent of the 2010 regional population) (Table 1-11). Total reported quantity of water produced was 319,179 acre-feet, with a reported quantity of water loss of 50,620 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 15.9 percent (Table 1-11).

Table 1-11. Water Loss Audit – 2010 South Central Texas Water Planning Region

No.	Utility Name	Retail Pop Served	System Input Volume (acft)	Water Loss (acft)	Water Loss (%)	Total Cost Of Loss ($)
	Utilities with Input Volumes of Less Than 280 acft/yr					
1	ARROWHEAD WATER SYSTEM	96	14	14	98.7%	9,001
2	BERRY OAKS WATER CO	102	22	4	18.4%	7,448
3	BMWD BULVERDE HILLS	954	85	9	11.1%	1,969
4	BMWD GERONIMO FOREST WATER SYSTEM	477	62	13	21.2%	1,068
5	BMWD OAKLAND ESTATES	495	55	18	33.0%	4,265
6	BMWD WEST VIEW SUBDIVISION	636	59	16	28.0%	2,570
7	BMWD WOODS OF SPRING BRANCH	102	8	1	8.7%	635
8	CADILLAC WATER CORPORATION	62	53	5	9.6%	-
9	CARRIZO HILL WSC	708	116	4	3.1%	5,187
10	CITY OF AUSTWELL	192	27	9	35.8%	61,888
11	CITY OF BAYSIDE	400	32	1	3.4%	8,599,276
12	CITY OF BIG WELLS	704	91	16	17.5%	8,784
13	CITY OF CHRISTINE	465	28	2	6.3%	6,026
14	CITY OF FALLS CITY	601	102	17	16.7%	21,543
15	CITY OF LA COSTE	1,295	131	17	13.3%	10,956
16	CITY OF MARION	2,000	212	7	3.3%	5,745
17	CITY OF NATALIA	1,663	242	84	34.7%	22,390
18	CITY OF POINT COMFORT	781	177	(38)	-21.6%	(43,728)
19	CITY OF SMILEY	550	92	13	13.8%	4,818
20	CITY OF STOCKDALE	2,175	251	52	20.6%	74,316
21	CITY OF WOODSBORO	1,685	222	54	24.3%	44,330
22	CREEKWOOD ESTATES	762	66	16	24.0%	5,539
23	CREEKWOOD RANCHES WSC	465	39	4	11.3%	9,916
24	DALE WSC	480	41	8	18.8%	2,359
25	EAGLES PEAK RANCH WSC	150	22	5	22.9%	1,395
26	EAST MEDINA COUNTY SUD UNIT 2	2,700	233	57	24.4%	43,536
27	EAST MEDINA COUNTY SUD UNIT 3	800	49	3	6.8%	2,673
28	FASHING PEGGY WSC	435	53	18	34.4%	11,846
29	FRIO CIELO RANCH ASSOCIATION WATER SYSTEM	47	13	1	10.0%	-
30	GBRA CALHOUN COUNTY RURAL WATER SYSTEM	3,909	241	21	8.7%	19,839
31	GBRA CORDILLERA RANCH	500	195	27	14.1%	31,354
32	GBRA PORT LAVACA	-	169	68	40.1%	55
33	GREY FOREST WATER SYSTEM	420	59	0	0.4%	135
34	HICKORY HILL WATER	291	30	10	33.0%	6,337
35	KENDALL COUNTY UTILITY CO	3,085	276	60	21.8%	92,578
36	KINGS POINT WSC	40	35	5	13.7%	1,759
37	KNIPPA WSC	750	125	25	19.8%	544
38	MOSS WOODS SUBDIVISION WATER SYSTEM	102	10	2	16.9%	535
39	NEW ALSACE WSC	200	30	8	27.2%	11,457

Table 1-11 (Continued)

No.	Utility Name	Retail Pop Served	System Input Volume (acft)	Water Loss (acft)	Water Loss (%)	Total Cost Of Loss ($)
40	NORTH POINT SUBDIVISION	68	7	1	8.5%	1,007
41	PICOSA WSC	714	172	22	13.0%	18,388
42	PLATTEN CREEK WATER SYSTEM	83	11	3	30.6%	4,780
43	POLONIA WSC SOUTH	1,626	228	72	31.5%	22,850
44	REBECCA CREEK MUD	1,308	127	49	38.3%	134,785
45	REFUGIO COUNTY WCID 1	630	70	5	7.1%	25,324
46	ROCKY CREEK SUBDIVISION WATER SYSTEM	90	9	2	25.4%	3,401
47	SCENIC HEIGHTS	1,935	134	25	18.4%	-
48	SEVEN OAKS WATER SUPPLY	135	13	2	18.1%	632
49	SHADY OAKS WATER COMPANY	357	39	9	22.5%	5,722
50	SJWTX GLENWOOD SUBDIVISION	190	40	5	12.0%	7,781
51	SJWTX STALLION SPRINGS	257	22	5	22.8%	8,299
52	SJWTX SUMMIT NORTH SUBDIVISION	22	7	4	60.9%	6,571
53	SPRING BRANCH INDIAN HILLS ESTATES WSC	471	35	4	11.1%	256
54	SUNILANDINGS UTILITIES	20	7	3	47.2%	1,195
55	THE OAKS WSC	1,161	244	30	12.2%	13,715
56	TRI COMMUNITY WSC	1,200	150	45	29.8%	13,742
57	UTOPIA WSC	744	74	22	29.5%	1,179
58	VILLE DALSACE WATER SUPPLY	250	47	0	0.9%	467
59	WEST MEDINA WSC	960	213	43	20.4%	35,364
60	WESTHAVEN WATER COMPANY	270	79	40	50.6%	15,639
	Subtotal Utilities with Less Than 280 acft/yr	**3,770**	**5,493**	**1,048**	**19.1%**	**9,411,441**
	Utilities with Input Volumes of More Than 280 acft					
61	ATASCOSA RURAL WSC	9,321	1,041	128	12.3%	27,389
62	BENTON CITY WSC	13,491	1,407	365	25.9%	231,359
63	BMWD CASTLE HILLS	8,079	1,477	101	6.8%	46,833
64	BMWD CHAPARRAL	2,754	296	50	16.8%	16,333
65	BMWD HILL COUNTRY	39,714	9,788	1,582	16.2%	542,486
66	BMWD NORTH WEST	50,073	5,584	753	13.5%	146,647
67	BMWD NORTHEAST	45,375	4,808	639	13.3%	127,637
68	BMWD SOUTHSIDE	106,590	15,639	4,371	28.0%	700,022
69	BMWD TIMBERWOOD PARK	16,215	2,355	504	21.4%	89,091
70	CITY OF BOERNE	11,432	1,827	153	8.4%	81,582
71	CITY OF CASTROVILLE	2,808	569	119	20.9%	126,559
72	CITY OF CIBOLO	15,000	1,325	(31)	-2.3%	(96,495)
73	CITY OF CONVERSE	22,284	2,044	356	17.4%	169,961
74	CITY OF COTULLA	3,614	1,399	577	41.2%	263,055
75	CITY OF CUERO	6,640	1,627	393	24.2%	48,221
76	CITY OF DEVINE	4,140	658	101	15.3%	66,153
77	CITY OF DILLEY	3,674	1,037	227	21.9%	91,620
78	CITY OF GARDEN RIDGE	3,450	1,020	71	6.9%	226,976
79	CITY OF GOLIAD	2,059	346	68	19.7%	106,874

Table 1-11 (Continued)

No.	Utility Name	Retail Pop Served	System Input Volume (acft)	Water Loss (acft)	Water Loss (%)	Total Cost Of Loss ($)
80	CITY OF JOURDANTON	3,909	681	113	16.6%	25,889
81	CITY OF KIRBY	8,673	860	180	21.0%	27,379
82	CITY OF LA VERNIA	1,134	296	68	23.0%	44,054
83	CITY OF LIVE OAK	8,120	1,281	36	2.8%	18,756
84	CITY OF LOCKHART	12,700	1,637	151	9.2%	175,695
85	CITY OF LULING	5,401	688	35	5.1%	32,771
86	CITY OF LYTLE	3,700	491	115	23.5%	75,122
87	CITY OF NEW BRAUNFELS UTILITIES	61,410	11,355	1,239	10.9%	891,007
88	CITY OF NIXON	2,246	797	9	1.1%	4,327
89	CITY OF PEARSALL	7,157	1,256	(46)	-3.7%	(4,646,115)
90	CITY OF POTH	1,850	334	69	20.7%	86,869
91	CITY OF REFUGIO	2,941	520	23	4.4%	22,585
92	CITY OF SCHERTZ	35,058	4,152	130	3.1%	79,809
93	CITY OF SEGUIN	21,126	5,994	718	12.0%	561,889
94	CITY OF UNIVERSAL CITY	19,084	2,558	233	9.1%	172,609
95	CITY OF VICTORIA	62,592	10,955	967	8.8%	419,148
96	CITY OF YOAKUM	5,815	968	136	14.1%	13,036
97	CLWSC CANYON LAKE SHORES	9,253	1,470	199	13.5%	341,838
98	CLWSC TRIPLE PEAK PLANT	12,427	1,626	480	29.5%	786,650
99	CRYSTAL CLEAR WSC	13,506	1,670	294	17.6%	223,942
100	EAST MEDINA COUNTY SUD UNIT 1	5,300	541	155	28.6%	117,506
101	EL OSO WSC	4,803	757	294	38.8%	221,887
102	GONZALES COUNTY WSC	7,140	1,661	431	26.0%	151,952
103	GREEN VALLEY SUD	33,128	2,675	220	8.2%	0
104	KENDALL COUNTY WCID 1	2,700	300	50	16.8%	13,435
105	MAXWELL WSC	5,700	466	90	19.3%	67,493
106	MCCOY WSC	8,900	832	134	16.1%	87,430
107	OAK HILLS WSC	4,359	568	59	10.4%	24,713
108	POLONIA WSC NORTH	4,464	493	96	19.5%	17,969
109	PORT OCONNOR MUD	4,308	315	29	9.3%	18,168
110	S S WSC	13,104	1,530	104	6.8%	79,081
111	SAN ANTONIO WATER SYSTEM	1,360,284	195,662	31,458	16.1%	14,996,067
112	SPRINGS HILL WSC	25,000	2,635	528	20.0%	585,540
113	SUNKO WSC	3,720	440	56	12.8%	16,253
114	YANCEY WSC	5,543	640	140	21.8%	46,517
115	ZAVALA COUNTY WCID 1	1,770	335	54	16.1%	14,365
Subtotal Utilities with More than 280 acft/yr		**2,155,038**	**313,686**	**49,572**	**15.8**	**18,827,938**
	TOTAL	**2,198,808**	**319,179**	**50,620**	**15.9**	**28,239,379**

1.11 Drought of Record

The historic drought of record for the Guadalupe – San Antonio River Basin of the South Central Texas Region is that which occurred primarily in the 1950s. Although the drought of 2011 was quite severe in terms of combined gaged streamflows for the Guadalupe River at Victoria and the San Antonio River at Goliad, there were three consecutive years in the 1950s drought (1954-1956) during which streamflows in each year were less than those in 2011. Similarly, total Edwards Aquifer recharge in 2011 was twice that for 1956. Focusing on Edwards Aquifer recharge in the Nueces River Basin only, recharge in 2011 was 28 percent greater than that in 1956. Even though the current drought has persisted through the preparation of this plan, moving average analyses of Edwards Aquifer recharge indicate that current drought is less severe than that of the 1950s for durations ranging from 1 to 10 years. Hence, it is appropriate to use the 1950s drought as the drought of record for evaluation of existing supplies and water management strategies in the 2016 South Central Texas Regional Water Plan.