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CHAPTER 1.0: INTRODUCTION AND DESCRIPTION OF THE LOWER COLORADO REGIONAL WATER PLANNING AREA

1.1 INTRODUCTION TO THE PLANNING PROCESS

Sections 16.051 and 16.055 of the Texas Water Code direct the Executive Administrator of the Texas Water Development Board (TWDB) to prepare and maintain a comprehensive State Water Plan. The overall goal of the State Water Plan is to address water supply needs at the local level with the consideration of balancing affordable water supply availability and conserving the State's natural resources and serves as a flexible guide for the development and management of all water resources in Texas.

In February 1998, the TWDB adopted rules establishing 16 regional water planning areas. Each planning area is responsible for preparing a consensus-based Regional Water Plan that will provide for the water needs of its region for the next 50 years. The TWDB incorporates the resulting Regional Water Plans into the State Water Plan, which is updated in 5-year cycles. Four previous Region K Water Plans have been completed (in years 2001, 2006, 2011, 2016) and were subsequently incorporated into the 2002, 2007, 2012 and 2017 State Water Plans. It is anticipated that the current cycle of Regional Water Plans will be finalized and adopted by January 2021. Subsequently, by approximately January 2022, the TWDB will prepare a new State Water Plan.

The Lower Colorado Regional Water Planning Area, initially designated by the TWDB as "Region K," encompasses all or part of 14 counties mostly within the Lower Colorado River Basin from the Hill Country to the Gulf of Mexico (*Figure 1.2*). The Lower Colorado Regional Water Planning Group (LCRWPG), representing the 11 TWDB-required interest groups, Groundwater Management Area representatives, and one additional regional interest group, is responsible for the development of the Lower Colorado Regional Water Plan (*Table 1.1*). The TWDB's guidelines require that each regional water plan include the following sections:

- Description of the region (Chapter 1)
- Population and water demand projections (Chapter 2)
- Estimates of currently available water supplies (Chapter 3)
- Identification of Water Needs (Chapter 4)
- Evaluation and selection of water management strategies, including a subsection on water conservation (Chapter 5)
- Impacts of selected water management strategies on key parameters of water quality and impacts of moving water from rural and agricultural areas (Chapter 6)
- Drought response information, activities, and recommendations (Chapter 7)
- Unique stream segments/reservoir sites and Legislative recommendations (Chapter 8)
- Report to Legislature on water infrastructure funding (Chapter 9)
- Public participation and education/input (Chapter 10)
- Report on implementation and comparison of the previous regional water plan (Chapter 11)

Figure 1.1: TWDB Designated Regional Water Planning Areas

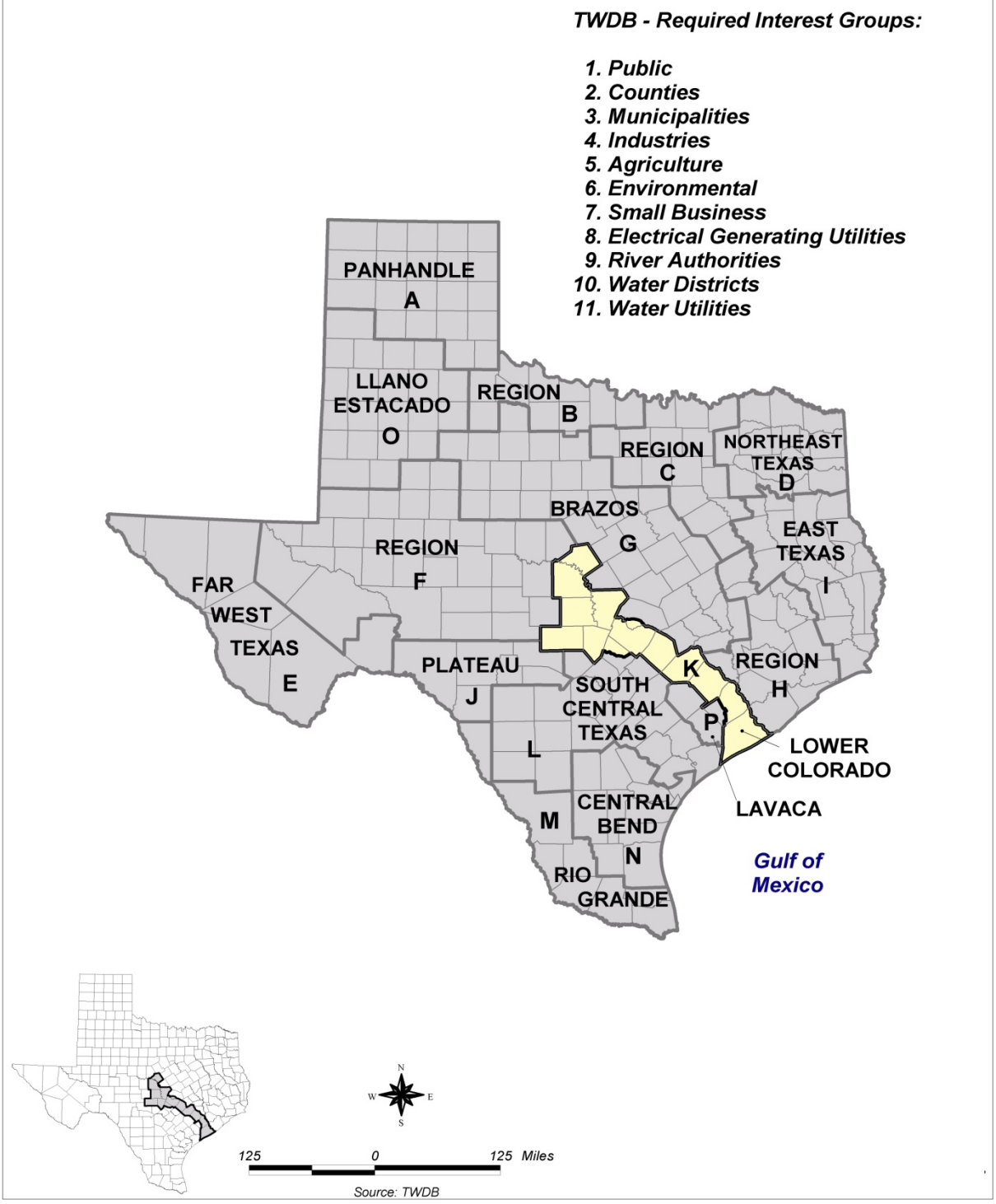


Figure 1.2 Lower Colorado Regional Water Planning Area (Region K)

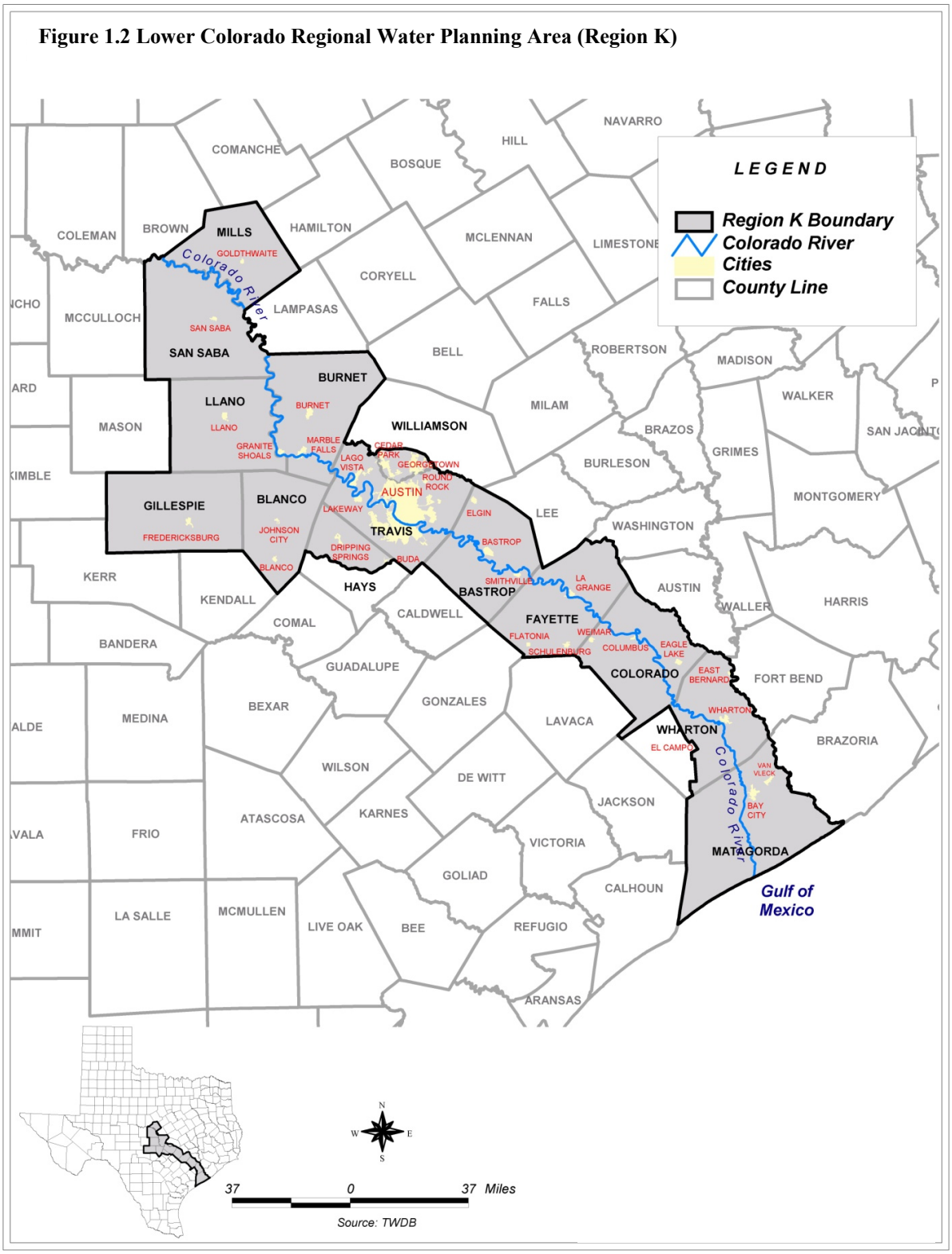


Table 1.1a: The Lower Colorado Regional Water Planning Group Voting Members and Alternates

Interest	Name	Entity	County (Location of Interest)	Alternate Member
Public	Karen Haschke	League of Women Voters	Travis	Carol Olewin
Counties	Byron Theodosis	San Saba County Judge	San Saba	N/A
	James Sultemeier	Blanco County Commissioners Court	Blanco	Emil Uecker
	Jim Luther	Burnet County Commissioners Court	Burnet	Linda Raschke
Municipalities	Mike Reagor	City of Llano	Llano	Scott Edmonson
	Lauri Gillam	N/A	Travis	Earl Foster
	Teresa Lutes	City of Austin	Travis/Williamson	Marisa Flores Gonzalez
Industries	Barbara Johnson	N/A	Travis	Terry Bray
Agricultural	Charles Olfers	Gillespie County Commissioners Court	Gillespie	Keith Kramer
	Paul Sliva	Farmer	Matagorda	N/A
Environmental	Ann McElroy	Self / Water Advocate	San Saba	N/A
	Jennifer Walker	National Wildlife Federation, South Central Region	Travis	Charlie Flatten
Small Businesses	Daniel Berglund	Self / Farmer / Coastal Bend GCD	Wharton	Ronald Gertson
	Robert Ruggiero	Self / Consulting Hydrogeologist	Travis	Marcus Richardson
Electric Generating Utilities	Jason Ludwig	STP Nuclear Operating Company	Matagorda	Ken Cunningham
River Authorities	David Wheelock	Lower Colorado River Authority	Travis	Rebecca Batchelder
Water Districts	David Van Dresar	Fayette County Groundwater Conservation District	Fayette	N/A
Water Utilities	John Burke	John Burke and Associates	Bastrop	Christianne Castleberry
Recreation	David Lindsay	Central Texas Water Coalition	Travis	Doug Powell
GMA 7	Paul Tybor	Hill Country Underground Conservation District	Gillespie	N/A
GMA 8	Mitchell Sodek	Central Texas GCD	Burnet	Paul Babb
GMA 9	Ronald Fieseler	Blanco-Pedernales GCD	Blanco	Paul Babb
GMA 10	David Caldwell	GMA 10	Hays/Travis	Robin Gary
GMA 12	Jim Totten	Lost Pines GCD	Bastrop	N/A
GMA 15	Jim Brasher	Colorado County GCD	Colorado	N/A

Table 1.1b: The Lower Colorado Regional Water Planning Group Nonvoting Members

Name	Entity
David Bradsby	Texas Parks & Wildlife Department
Rob Barthen	Texas Department of Agriculture
Rusty Ray	Texas State Soil & Conservation Board
Lann Bookout	Texas Water Development Board

Texas is an extremely diverse state, both in climate and economics. This diversity requires the use of a variety of water management strategies, the combination of which will be unique for each of the 16 regions. The types of strategies that may be considered include, but are not limited to:

- expected/advanced water conservation
- drought management
- water reuse
- expanded use of existing supplies
- subordination of water rights
- new supply development
- yield enhancement measures
- inter-basin and emergency transfers

Water availability, economics, environmental concerns, and public acceptance were considered during the process of developing water management strategies within each region. The final Regional Water Plan must comply with all existing state and federal regulations regarding existing water rights, instream flows, bay/estuary freshwater inflows, water quality, threatened/endangered species, critical habitats, and sites of historical importance.

The overall goal of the State Water Plan is to address water supply needs at the local level with the consideration of balancing affordable water supply availability and conserving the State's natural resources.

1.2 DESCRIPTION OF THE LOWER COLORADO REGIONAL WATER PLANNING AREA

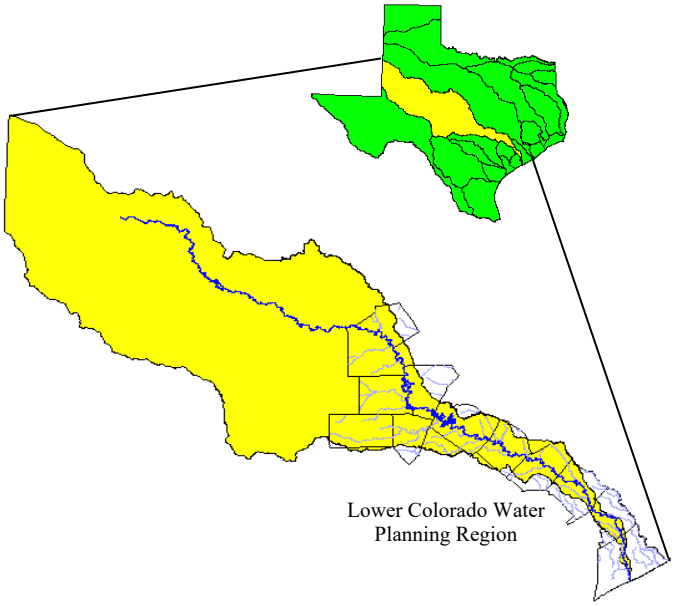
The Lower Colorado Regional Water Planning Area encompasses all or part of the following counties:

- Bastrop
- Blanco
- Burnet
- Colorado
- Fayette
- Gillespie
- Hays (partial)
- Llano
- Matagorda
- Mills
- San Saba
- Travis
- Wharton (partial)
- Williamson (partial)

Most of the Lower Colorado Region lies within the Colorado River Basin and crosses the Great Plains and the Coastal Plains physiographic provinces. The following sections provide a general description of the area's physical and socioeconomic characteristics, as well as water quality and natural resource issues of importance to the region.

1.2.1 Physical Characteristics of the Lower Colorado Regional Water Planning Area[1]

Figure 1.3: The Colorado River Basin



The headwaters of the Colorado River Basin are located in eastern New Mexico, and the basin extends approximately 900 miles to the Texas Gulf Coast, ending at Matagorda Bay as shown in *Figure 1.3*. The full extent of the basin exceeds the boundaries of the Lower Colorado Regional Planning Area. The Colorado River Basin is bordered by the Brazos River Basin to the north and east, and by the Guadalupe River and Lavaca River Basins to the south and west. The total drainage area of the Colorado River is 42,318 sq. mi, 11,403 sq. mi of which is considered non-contributory to the river's water supply. There are six major tributaries with drainage areas greater than 1,000 sq. mi that contribute to the Colorado River: Beall's Creek and the Concho River, above the Region K boundary; and the San Saba, Llano, and Pedernales Rivers as well as Pecan Bayou. All of these major tributaries and approximately 90 percent of the entire contributing drainage for the river occur upstream of Mansfield Dam near Austin. This dam is the primary regulator of water flow from its location south to the Gulf of Mexico. Downstream of Austin, there are only two tributaries with drainage areas greater than 300 sq. mi: Onion Creek in Travis County and Cummins Creek in Colorado County.

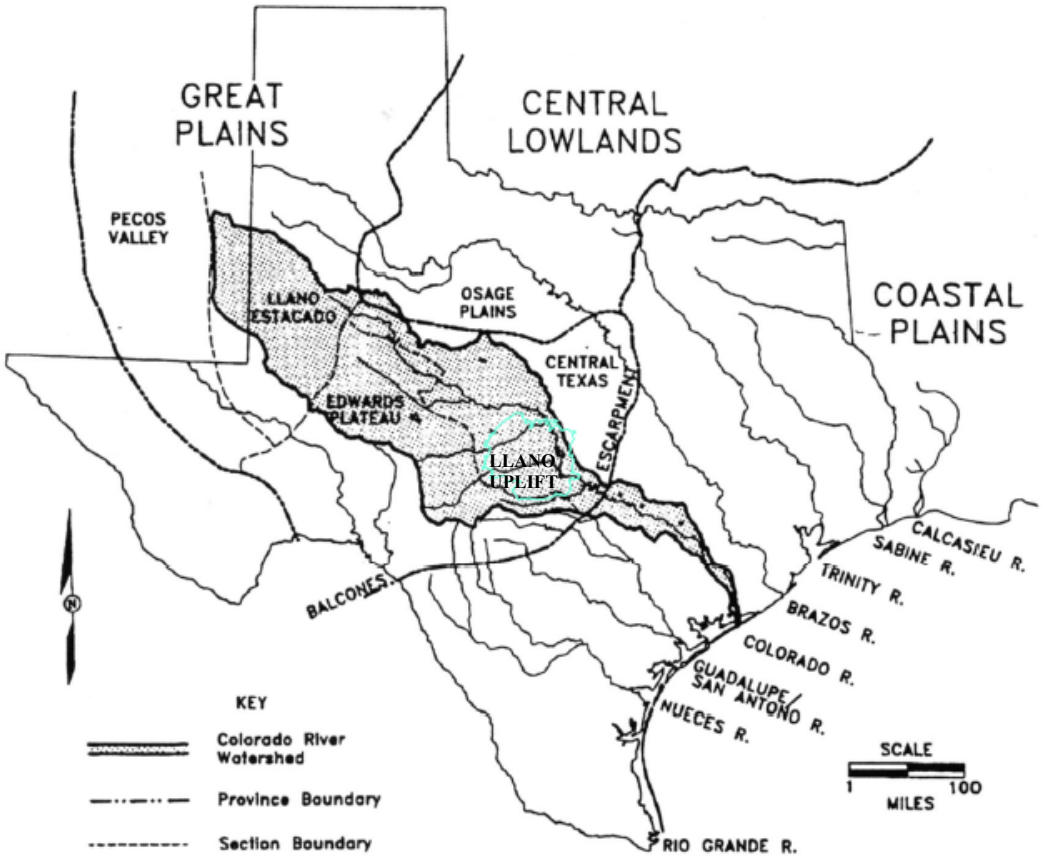
1.2.1.1 Geology of the Lower Colorado River Basin[2, 3]

The northernmost boundary of the Lower Colorado Regional Planning Area lies in the Central Texas section of the Great Plains physiographic province (*Figure 1.4*). It is here that the Colorado River intersects the Llano Uplift; a broad, low relief but highly structured area exposing early Paleozoic and Precambrian igneous and metamorphic formations. In the northwestern portion of the region, the major southern tributaries and the Colorado River drain the Edwards Plateau section of the Great Plains province, which is characterized by Cretaceous- aged limestone formations overlain by Tertiary-aged sediments. The Colorado River meanders through these limestone deposits in relatively steep narrow canyons in this area; however, there are also flat-topped remnants of the once more extensive Edwards Plateau. At the eastern edge of the Edwards Plateau, the Edwards Aquifer outcrops at several locations along the Balcones Fault Zone (shown as the Balcones Escarpment on Figure 1.4), creating aquifer recharge zones and associated natural discharge points or springs, such as Barton Springs in Travis County. Typical soils (*Figure 1.5*) of the Llano Uplift are reddish-brown to brown, neutral to slightly acidic, calcareous, sandy loams. Soils mapped on the Edwards Plateau section typically consist of dark, deep to shallow, stony, calcareous clays.

[1] Lower Colorado River Authority (LCRA), June 1992. *Instream Flows for the Lower Colorado River*, Final Report.
[2] LCRA, Op. Cit., June 1992.
[3] Texas Water Development Board (TWDB), May 1977. *Continuing Water Resource Planning and Development for Texas, Volume II.*

Figure 1.4: Physiographic Provinces and Major Drainage Basins of the Western Gulf Slope

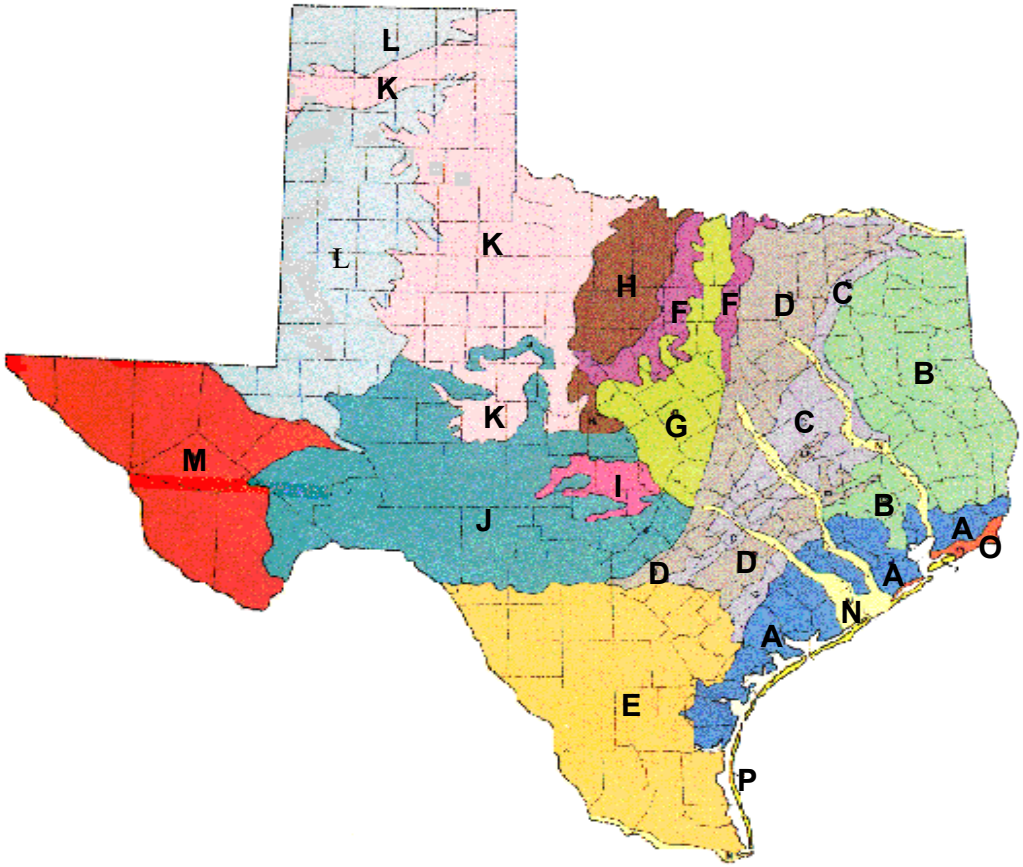
(Modified from Conner and Suttkus, 1977)



The Western Gulf Coast section of the Coastal Plains province contains the remaining 300 miles of the Colorado River south of the Balcones Fault Zone in Travis County to the Gulf of Mexico. The Western Gulf Coast section is characterized as an elevated sea bottom with low topographic relief ranging from low hills in the west to coastal flats. Surface geologic units mapped along this portion of the Colorado River include a relatively narrow band of Upper Cretaceous formations just southeast of the Balcones Fault Zone, followed by a belt of Tertiary deposits that outcrop from Bastrop County southeast to Colorado County. The remaining geologic units, from Colorado County to the Gulf of Mexico, are mapped as Quaternary-aged deposits. Sediments in the Western Gulf Coast section are composed primarily of marine deposits such as limestones, marls, and shales; however, the river valley also contains significant fluvial (river) terrace deposits of granitic assemblage, quartz and quartzite, chert, limestone, sandstone, siltstone, hornblende schist, silicified wood, and rip-up clasts. Colorado Basin soils in the Western Gulf Coast section are typically dark, neutral to slightly acidic, clay loams, and clays. Near the coast, soils become light, acidic sands, and darker, loamy to clayey soils.

Figure 1.5: Soils of Texas

(Source: Bureau of Economic Geology, 1977)



A Dark-colored, neutral to slightly acid clay loams & clays; some lighter colored sandy loams; acid soils mostly east of Trinity River.

B Light-colored, acid sandy loams, clay loams, & sands; some red soils & clays.

C Light-brown to dark-gray, acid sandy loams, clay loams, & clays.

D Dark-colored calcareous clays; some grayish-brown, acid sandy loams & clay loams along eastern edge of the major prairie & interspersed in minor prairies.

E Dark calcareous to neutral clays & clay loams; reddish-brown, neutral to slightly acid sandy loams; grayish-brown, neutral sandy loams & clay loams; some saline soils near coast.

F Light-colored, acid loamy sands & sandy loams.

G Dark-colored, deep to shallow clay loams, clays, & stony calcareous clays over limestone.

H Reddish-brown to grayish-brown, neutral to slightly acid sandy loams & clay loams; some stony soils.

I Reddish-brown to brown, neutral to slightly acid, gravelly & stony sandy loams.

J Dark, calcareous stony clays & clay loams.

K Dark-brown to reddish-brown, neutral to slightly calcareous sandy loams, clay loams, & clays.

L Dark-brown to reddish-brown neutral sands, sandy loams, & clay loams; some very shallow calcareous clay loams.

M Light reddish-brown to brown sands; clay loams & clays (mostly calcareous, some saline) & rough stony lands.

N Light-brown to reddish-brown, acid sandy loams; acid & calcareous clay loams & clays.

O Light- & dark-colored, acid sands, sandy loams, & clays.

P Tan, loose sand & shell material.

1.2.1.2 Climate[4, 5, 6, 7]

The climate across the State of Texas varies considerably; however, there are no natural boundaries, and changes occur gradually from east to west. In general, average temperatures, rainfall, and the length of the growing season decrease from the east to the north and west. The upper atmospheric winds, or jetstreams, affect the large-scale weather patterns in the state. The polar jetstream affects the movement of cold arctic air masses from December through February. The moist warm air masses are brought to Texas from the Pacific Ocean by the subtropical jetstream, whose influence is most prevalent during the spring and fall.

Region K lies entirely within the warm-temperate/subtropical zone. The constant flow of warm tropical maritime air from the Gulf of Mexico produces a humid subtropical climate with hot summers across the lower third of the region. This maritime air combines with cooler and drier continental air further inland, which results in a subtropical climate with dry winters and humid summers in the remainder of the region. Winters in Region K typically are mild with frequent, short duration surges of colder continental air masses and strong northerly winds. Average annual net evaporation in Region K varies from 20 to 24 inches at the coast to approximately 44 inches in the uppermost portion of the region (*Figure 1.6*).

The amount of rainfall varies across the Lower Colorado Planning Region from an average of 48 inches at the coast to 24 inches in the northwestern portion of the region (*Figure 1.7*). The rainfall distribution pattern in this region has two peaks: spring is typically the wettest season with a peak in May, and a second peak usually occurs in September and October, coinciding with the tropical cyclone season in the late summer/early fall. The spring rains are typified by convective thunderstorms that produce high intensity, short duration precipitation events with rapid runoff. These thunderstorms are generally caused by successive frontal systems that move through the state. These weak cold air masses are overrun by warm Gulf moisture, and the line of instability that develops where the two air masses collide produces thunderstorms. The fall seasonal rains are primarily governed by tropical storms and hurricanes that originate in the Caribbean Sea or the Gulf of Mexico and make landfall on the coast from Louisiana to Mexico. As the storm moves inland, the coverage area for a single tropical cyclone event can be quite large and the storm severe, with wind and flood damage common. Fall cold fronts can also bring widespread, heavy rain events.

[4] TWDB, Op. Cit., May 1977.
[5] Hatch, S. L., et al. July 1990. *Checklist of the Vascular Plants of Texas*. Texas Agricultural Experiment Station, College Station, Texas.
[6] Jones, B. D., 1990. *Texas Floods and Droughts. In National Water Summary 1988–1989*. U.S. Geological Survey, pp. 513–520.
[7] Nielson et al. January 2016. *The Effect of the Balcones Escarpment on Three Cases of Extreme Precipitation in Central Texas*

Figure 1.6: Lower Colorado Regional Water Planning Area (Region K) Average Annual Net Evaporation

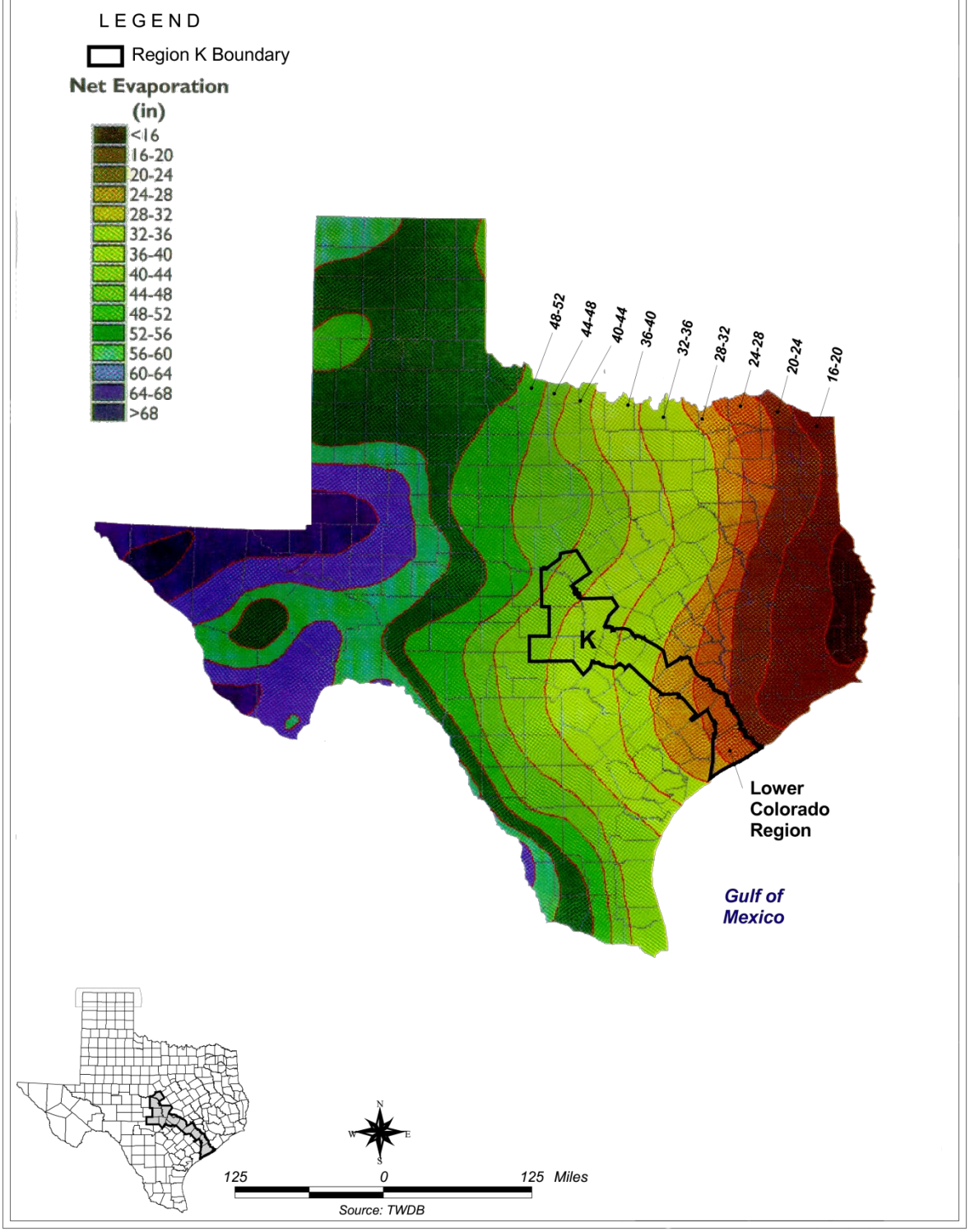
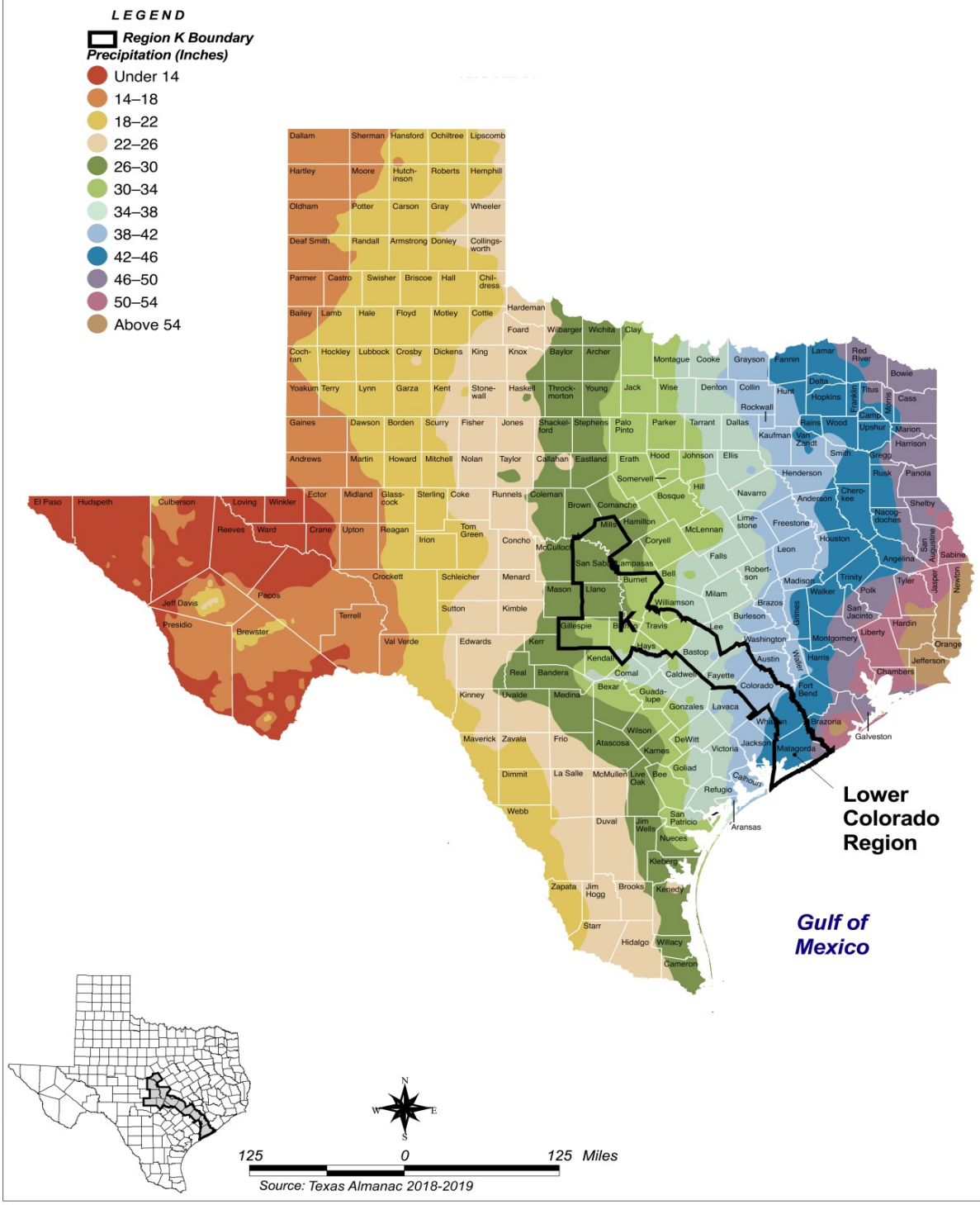


Figure 1.7: Lower Colorado Regional Water Planning Area (Region K) Average Annual Precipitation



The hydrologic characteristics of the Colorado River are closely linked to the precipitation patterns that occur in the river basin, especially the cycles of floods and droughts, which are common in Texas. Major flood and drought events are those with statistical recurrence intervals greater than 25 years and 10 years, respectively. Streamflow gaging data collection began in the early 1900s, and the data show that there has been a major drought in almost every decade of the last 100 years. Droughts in Texas are primarily the result of the presence of a strong subtropical high-pressure cell, called a Bermuda High, which becomes stationary over the state and prevents low-pressure fronts from passing through the state. Major droughts can cause stock ponds and small reservoirs to go dry and large reservoirs, such as Lake Travis, can drop their storage levels to less than one-third their capacity. The average annual runoff during the period from 1941 to 1970 ranged from 350 ac-ft/sq. mi near the mouth of the Colorado River to less than 50 ac-ft/sq. mi in the westernmost portion of the basin's contributing zone, which translates to an overall basin average of 81 ac-ft/sq. mi. During this 30-year time period there were three major statewide droughts: 1947 to 1948, 1950 to 1957, and 1960 to 1967. These periods of drought saw average annual runoff values decrease 72 to 80 percent, to 16 to 23 ac-ft/sq. mi, which resulted in record low flows in the Colorado River. The most severe of these droughts occurred from 2007 to 2016, in which 95 percent of the counties in the state were declared disaster areas by the U.S Department of Agriculture. The second most severe drought was from 1950 to 1957, in which 94 percent of the counties in the state were declared disaster areas. Considering the 1940 to 2016 time period, the drought of record for Region K is the period 2007 to 2016, and this drought of record period was used in this regional water planning effort for estimating reservoir firm yields. In some, if not all cases, the lowest single year flows in the period of record occurred in 2011 and this critical year period defines the availability of water from run-of-river water rights. This is discussed in more detail in *Chapter 7* of this Plan.

The end of a drought cycle is often marked by one or more flooding events, allowing aquifers and man-made water storage facilities to recharge. The Balcones Escarpment lies in Central Texas with the Edwards Plateau to the West and coastal plains to the east. The escarpment marks the transition between Texas hill country and the rich arable lands of the coastal plains and has been thought to worsen the severe flooding in the Central Texas. The floodplains of the upper Colorado River and its tributaries are typically steep, narrow channels with rocky soils and sparse vegetative cover. During intense rain events this allows for rapid runoff, resulting in sharp-crested floods with high peak discharges and velocities. The orthographic ascent of the Balcones Escarpment may contribute to the concentration of heavy precipitation in the area as well as when warm moist air from the Gulf of Mexico goes up the coastal plains and then meets the higher elevations and steeper slopes of the escarpment. A study completed at Colorado State University in 2015 found through computer modeling of several flood events that the Balcones Escarpment worsens flooding by focusing precipitation in Central Texas. Downstream, the floodplains become wider with denser vegetation, which decreases these streamflow velocities; however, the massive volumes of water moving down the river basin can still cause a great deal of flood damage.

Areas expected to be most prone to flood damage in the Lower Colorado Planning Region are along Lake Travis and Lake Austin, and the Cities of Austin, La Grange, Columbus, Wharton, and Matagorda. The Hill Country in Central Texas has experienced more severe flood events than any other region of the country. From 1843 to 1938, there were 22 major floods along the Colorado River. One of the most intense localized flash floods in the Lower Colorado Planning Region in recent history occurred 24 May 1981 in Austin. This storm produced a flood with a recurrence level greater than 100 years, caused $40 million in damages, and was responsible for 13 deaths. Another intense event occurred on 27 June 2007 in Marble Falls. This storm produced a flood with a recurrence level of greater than 500 years. In 2013, the Onion Creek Watershed in Travis County experience a flood with a recurrence level greater than 100 years on October 31st. The flood caused millions of dollars in damage and was responsible for several deaths. In 2015, flash

flooding during Memorial Day weekend was responsible for 14 deaths across Central Texas. Hays and Blanco counties were most severely impacted, but additional flooding on Memorial Day affected areas of Williamson, Travis and Bastrop counties. In October 2018, after significant periods of low inflows to the Highland Lakes, rainfall levels caused severe flooding on the Llano River, Sandy Creek, and areas on the Highland Lakes, resulting in more than 1.3 million ac-ft of inflows to the Highland Lakes, the fourth highest of any month on record. As noted on the LCRA website, Lake Travis reached an elevation of 704.39 feet above mean sea level, its fifth highest elevation in history.

Historically, the coastal portion of the river basin is affected by hurricanes two of every five years. Hurricane Harvey, the wettest tropical cycle on record in the United States, hit Texas on 25 August 2017. A disaster declaration was issued for counties in the Lower Colorado Planning Region, including Colorado, Fayette, Matagorda, and Wharton counties; this list was later amended to include Bastrop County. Hurricane Harvey killed 68 people and caused an estimated $125 billion in damages in the state of Texas.

In 2018, the Texas Water Development Board prepared the *State Flood Assessment*, a report that included a history of flooding in Texas; the roles of local, state, and federal agencies relative to preparing for, mitigating, and recovering from floods; a summary of planning and infrastructure needs; and stakeholder input on how flood planning should proceed in the state. The report also discussed potential synergies between water supply and flood control.

As part of the City of Austin *Water Forward Plan*[8], the City of Austin analyzed the potential impacts of climate change on the City's future water needs. Their modeling efforts show while average rainfall can be expected to stay fairly constant over the next several decades, it is also expected that the periods of drought will increase in severity, interrupted by heavy precipitation. Accounting for these periods of drought and flood in planning future water supplies will be important.

1.2.1.3 Vegetational Areas[9]

Natural regions, or vegetation areas, are based on the interaction of geology, soils, physiography, and climate. There are ten vegetational areas that cross the State of Texas and five of these intersect Region K (*Figure 1.8*). These are the Cross Timbers and Prairies, the Edwards Plateau, the Blackland Prairies, the Post Oak Savannah, and the Gulf Prairies and Marshes. Each of these vegetation areas is described below. *Figure 1.9* shows the dominant plant species that occur in Region K.

The **Cross Timbers and Prairies** vegetational area includes all of Mills County, most of Burnet County, the north portions of San Saba and Travis Counties, and the section of Williamson County within the Lower Colorado Planning Region. This region falls within the southern extension of the Central Lowlands and the western edge of the Coastal Plains physiographic provinces. There are sharp contrasts in topography, soils, and vegetation in this region due to the wide variety of geologic formations in the area. Elevations range from 500 feet to 1,500 feet above mean sea level. Cross Timber soils are typically of the orders Mollisol and Alfisol. In the East and West Cross Timbers subregions, soils range from light, slightly acid loamy sands and sandy loams with yellowish-brown to red clayey subsoils in the upland areas to dark, neutral to calcareous clayey bottomland soils, and loamy alluvial soils along minor streambeds. The North Central Prairies subregion is interspersed with sandstone and shaley ridges and hills. Uplands are brown sandy loam

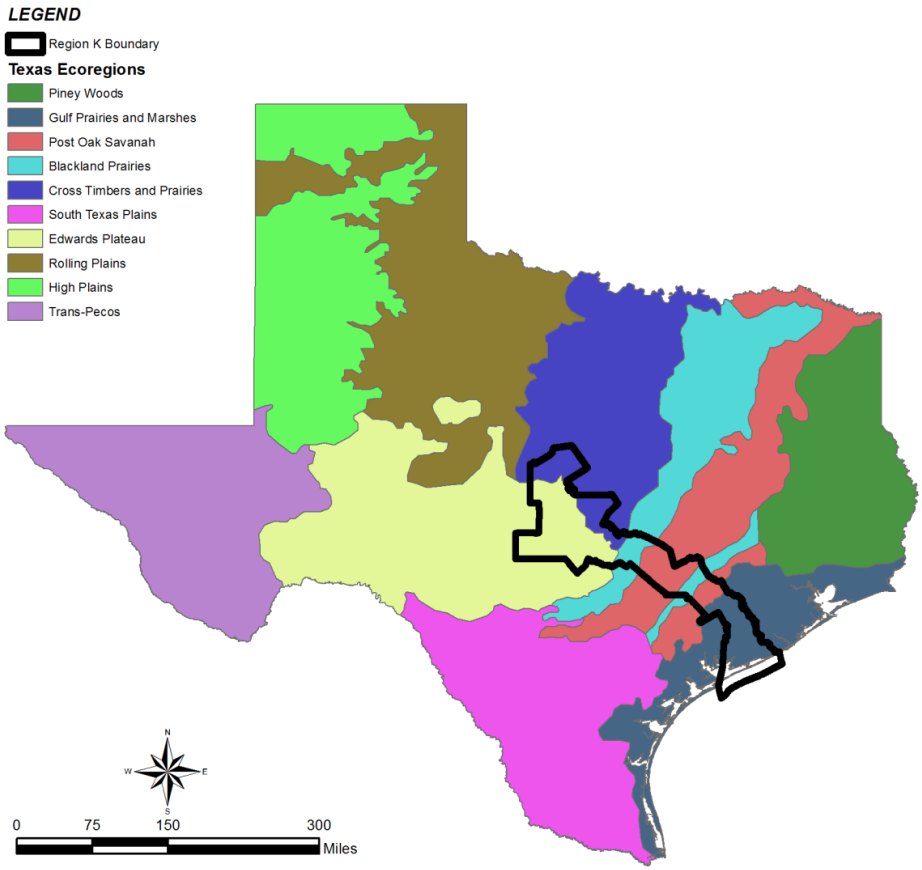
[8] *Water Forward Integrated Water Resource Plan*, Austin Water, November 2018.
[9] Hatch, et al., Op. Cit., July 1990.

to silt loam, slightly acid soils that overlay red to gray, neutral to alkaline clayey subsoils. The bottomlands have brown to dark gray, loamy, and clayey, neutral to calcareous, and alluvial soils.

The Cross Timbers and Prairies support tallgrasses such as big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and Canada wildrye (*Elymus canadensis*), with minor populations of midgrasses and shortgrasses such as sideoats grama (*Bouteloua curtipendula*), blue grama (*B. gracilis*), hairy grama (*B. hirsuta*), Texas wintergrass (*Stipa leucotricha*), and buffalograss (*Buchloe dactyloides*). Overgrazing has allowed the midgrasses and shortgrasses to increase their range and has allowed the invasion of scrub oak (*Quercus turbinella*), honey mesquite (*Prosopis glandulosa*), and Ashe juniper (*Juniperus ashei*) in upland areas, as well as hairy tridens (*Erioneuron pilosum*), Texas grama (*Bouteloua rigidiseta*), red Bottomland trees

Figure 1.8: Vegetational Areas of Texas

Source: Texas Parks and Wildlife



include pecan (*Carya illinoensis*), oak (*Quercus*), and elm (*Ulmus*), with invasion of mesquite. Typical shrubs and vines include skunkbush (*Rhus aromatica*), saw greenbriar (*Smilax bona-nox*), bumelia (*Bumelia lanuginosa*), and poison ivy (*Rhus toxicodendron*). White-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), squirrel (*Sciurus spp*.), bob white quail (*Colinus virginianus*), and mourning dove (*Zenaida macroura*) are plentiful.

The **Edwards Plateau** vegetational area consists of an area of West Central Texas commonly known as the "Hill Country" and includes the majority of Hays County within the Lower Colorado Planning Region; all of Llano, Gillespie, and Blanco Counties; most of San Saba County; southern Burnet County; and western Travis County. The geologic formation known as the Balcones Escarpment forms the eastern and southern boundary of this region. Elevations range from 1,200 feet to over 3,000 feet above mean sea level, and the landscape is deeply dissected, hilly, rough, and well drained. Edwards Plateau soils are typically shallow Entisols, Mollisols, or Alfisols that have a variety of surface textures and are underlain by limestone.

Historically, the natural vegetation of the Edwards Plateau was grassland or open savannah-type plains with trees or brush along rocky slopes and streambeds. Tallgrasses such as cane bluestem (*Bothriochloa barbinodis*), big bluestem, little bluestem, Indiangrass, and switchgrass, are still common today along rocky outcrops and protected areas with good soil moisture. In areas with more shallow soils, tallgrasses have been replaced by midgrasses and shortgrasses such as sideoats grama, Texas grama, and buffalograss. Typical wildflowers are Engelmann daisy (*Engelmannia pinnatifida*), orange zexmania (*Wedelia hispida*), western ragweed (*Ambrosia psilostachya*), and sneezeweed (*Helenium quadridentatum*). Areas disturbed by over-grazing have been invaded by pricklypear (*Opuntia*), bitterweed (*Hymenoxys odorata*), broadleaf milkweed (*Asclepias latifolia*), smallhead sneezeweed (*H. microcephalum*), broomweeds (*Amphiachyris* and *Gutierrezia*), prairie coneflower (*Ratibida columnifera*), mealycup sage (*Salvia farinacea*), and tasajillo (*Opuntia leptocaulis*). Common woody species are live oak (*Quercus virginiana*), sand shin oak (*Quercus havardii*), post oak (*Quercus stellata*), mesquite, and juniper.

Land suitable for cultivation occurs only along narrow streams and divides within the Edwards Plateau region and in these areas tree orchards are common. The majority of the region is utilized as rangeland for the production of livestock and wildlife. This area was once one of the major wool and mohair producers in the country, providing up to 98 percent of the nation's mohair. Over the last three decades, however, many factors have contributed to the decline of the fiber industry including labor/shearer shortages, prices, changing land use, increase of predators (coyotes), and the loss of federal subsidies which had been paid by tariffs and opened foreign markets. The Edwards Plateau also supports the highest deer densities in North America, and exotic big game ranches have increased across the region.

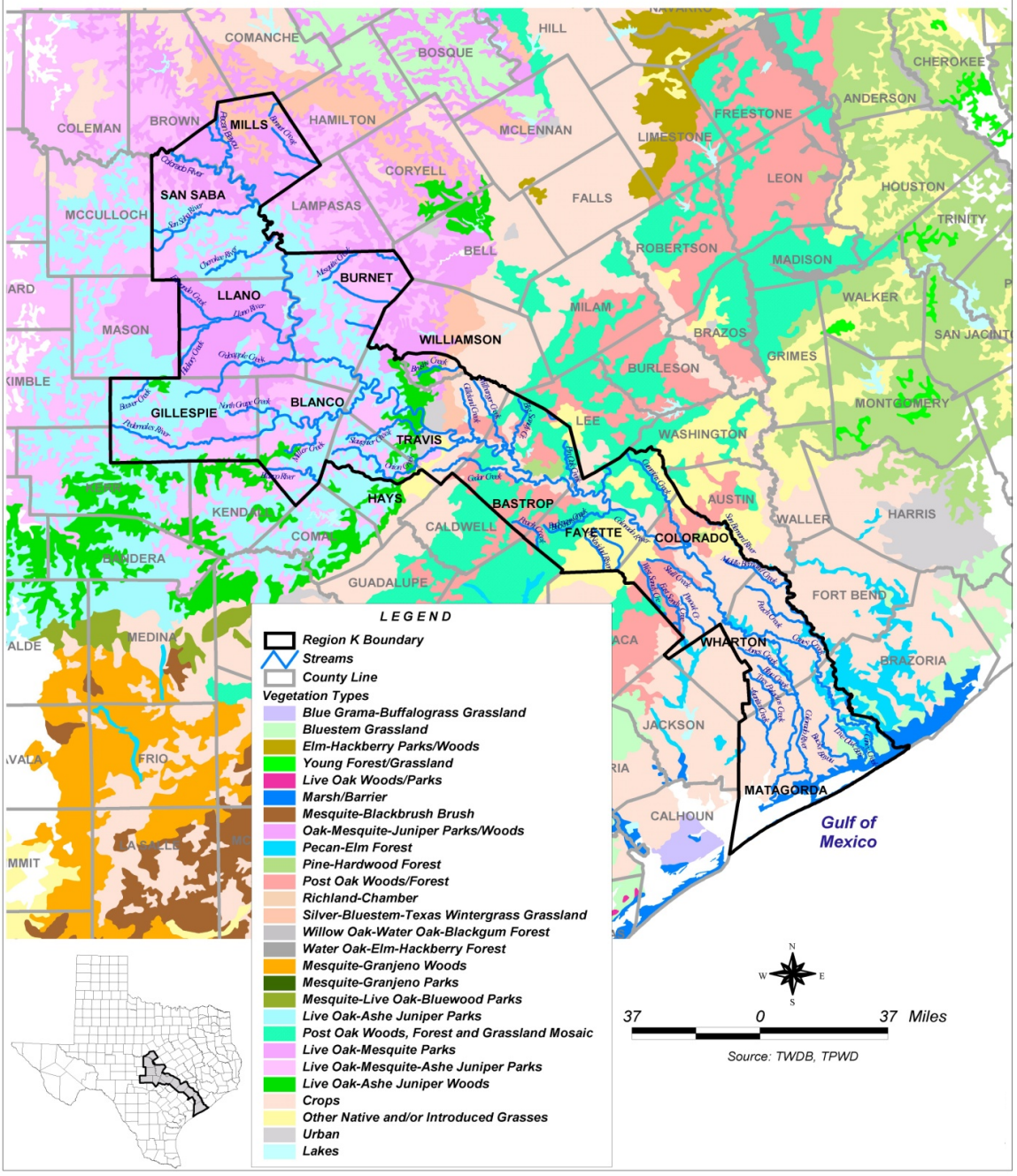
Within Region K, the **Blackland Prairies** vegetational area occurs in eastern Travis County, several small sections of Bastrop County, portions of Fayette County and Colorado County, and a small area of Hays County. The characteristic topography is gently rolling hills to nearly level with well-defined contours for rapid surface drainage. Elevation varies from 250 to 700 feet above mean sea level. Major soil orders include Vertisols and Alfisols, which are naturally very productive and fertile. Upland soils are dark, calcareous, and clayey. Bottomland soils are typically reddish-brown to dark gray, slightly acid to calcareous, loamy to clayey to alluvial.

The Blackland Prairie once supported a tallgrass prairie dominated by big bluestem, little bluestem, Indiangrass, tall dropseed (*Sporobolus asper*), and Silveus dropseed (*S. silveanus*). Minor species including sideoats grama, hairy grama, Mead's sedge (*Carex meadii*), Texas wintergrass, and buffalograss have increased due to grazing pressure. Erosion and agricultural activities have decreased the productivity of

these soils. Common wildflowers include asters (*Aster*), prairie bluet (*Hedyotis nigricans*), prairie-clover (*Petalostemon*), and late coneflower (*Rudbeckia serotina*). Typical legumes are snoutbeans (*Rhynchosia*), and vetch (*Vicia*). Areas disturbed by grazing and agriculture have been invaded by mesquite, huisache (*Acacia smallii*), oak, and elm trees. Oak, elm, cottonwood (*Populus deltoides*), and native pecan can be found in moist drainage areas. Isolated areas of Blackland Prairies are intermingled within the Post Oak Savannah vegetation area.

In the latter 19th and early 20th centuries, most of the Blackland Prairies vegetational area had been converted to cropland. Pastureland and livestock forage cropland began to increase in the 1950s, and by the year 2000 only 50 percent of the area was used for cropland. Significant game species include dove, bobwhite quail, and squirrel.

Figure 1.9: Lower Colorado Regional Water Planning Area (Region K) Vegetation Distribution



The **Post Oak Savannah** vegetational area within Region K occurs in most of Bastrop, Colorado, and Fayette Counties. The region is characterized by gently rolling, moderately dissected wooded plains with elevations between 300 feet and 800 feet above mean sea level. There are several areas of Blackland Prairie intermingled in the southern portion of the Post Oak Savannah. Typically shallow upland soils are gray, slightly acid sandy loams that overlay gray, mottled, or red, firm clayey subsoils. Infiltration-resistant claypan layers occur at varying soil depths, which impedes the percolation of moisture. Bottomland soils are reddish-brown to dark gray, slightly acid to calcareous, loamy to clayey alluvial.

Typically, short oak trees, such as post oak and blackjack oak (*Q. marilandica*), are interspersed among the tallgrass species of little bluestem, silver bluestem (*Bothriochloa saccharoides*), Indiangrass, switchgrass, and midgrass and shortgrass species of Texas wintergrass (*Stipa leucotricha*), purpletop (*Tridens flavus*), narrowleaf woodoats (*Chasmanthium sessiliflorum*), and beaked panicum (*Panicum anceps*). Elms, junipers, hickories (*Carya*), and hackberries (*Celtis*) are also common trees here. Shrubs and vines such as yaupon (*Ilex vomitoria*), American beautyberry (*Callicarpa americana*), coralberry (*Symphoricarpos orbiculatus*), greenbriar (*Smilax*), and grapes (*Vitis*) are typical. Historically, periodic wildfires have suppressed the overgrowth of brush and trees, and in their absence thickets tend to form. Wildflowers characteristic of the true prairie species include wild indigo (*Babtisia*), indigobush (*Amorpha fruticosa*), senna (*Cassia*), tickleclover (*Desmodium*), lespedezas (*Lespedeza*), prairie-clovers, western ragweed, crotons (*Croton*), and sneezeweeds.

The Post Oak Savannah was extensively cultivated through the 1940s; however, today many acres have been returned to native habitat or tame pastureland, which have been seeded with nonnative species such as bermudagrass, bahiagrass, weeping lovegrass, and clover. The region supports game species such as deer, squirrel, and quail.

The Bastrop County Complex fire, which ignited on September 4, 2011, struck Bastrop County, destroying over 1,600 residential structures and impacting 32,000 acres of land and habitat. According to Texas Parks and Wildlife officials, only 50-100 acres of the Bastrop State Park's 6,565-acre premises remained undamaged following the wildfire. The endangered Houston toad was believed to have lost the vast majority of its habitat in the fire. The Lost Pines Forest, a disjunct population of loblolly pine trees thought to have originated in or before the Pleistocene era, was heavily affected by the fire.

The **Gulf Prairies and Marshes** vegetational area encompasses all of Matagorda County, the entire portion of Wharton County within Region K, and the eastern tip of Colorado County. This is a 30- to 80-mile-wide strip of lowlands adjacent to the Texas coast from the Louisiana border to the Mexico border. The landscape consists of low, wet coastal marshes, and nearly flat, undissected plains with elevations from sea level to 250 feet. Marsh soils are typically dark, poorly drained, saline and sodic, sandy loams, and clays, and light neutral sands. Prairie soils are characterized by dark, neutral to slightly acid clay loams, and clays, with a narrow belt of light acid sands and darker loamy to clayey soils along the coast. Bottomland and delta soils are typically reddish-brown to dark gray, slightly acid to calcareous, loamy to clayey alluvial.

Original Gulf Prairie vegetation consisted of tallgrasses and post oak savannah. Today, however, trees and shrubs such as honey mesquite, oaks, acacia, and bushy sea-ox-eye (*Borrichia frutescens*) have formed thickets in many areas. Characteristic tallgrasses include gulf cordgrass (*Spartina spartinae*), big bluestem, little bluestem, Indiangrass, eastern gamagrass (*Tripsacum dactyloides*), gulf muhly (*Muhlenbergia capillaris*), tanglehead (*Heteropogon contortus*), as well as *Panicum* and *Paspalum* species. Typical wildflowers include asters, Indian paintbrush (*Castilleja indivisa*), poppy mallows (*Callirhoe*), phloxs (*Phlox*), bluebonnets (*Lupinus*), and evening primroses (*Oenothera*). Common invaders such as

yankeeweed (*Eupatorium compositifolium*), broomsedge bluestem (*Andropogon virginicus*), smutgrass (*Sporobolus indicus*), western ragweed, tumblegrass (*Schedonnardus paniculatus*), threeawns (*Aristida*), pricklypear, and many annual wildflowers and grasses have increased their ranges. Saline Gulf Marsh areas support species of sedges (*Carex* and *Cyperus*), rushes (*Juncus*), bulrushes (*Scirpus*), cordgrasses (*Spartina*), seashore saltgrass (*Distichlis spicata*), common reed (*Phragmites australis*), marshmillet (*Zizaniopsis miliacea*), longtom (*Paspalum lividum*), seashore dropseed (*Sporobolus virginicus*), and knotroot bristlegrass (*Setaria geniculata*). Marshmillet and maidencane (*Panicum hemitomon*) are two important freshwater grass species found in the upper coast. Typical aquatic forbs include pepperweeds (*Lepidium*), smartweeds (*Polygonum*), docks (*Rumex*), bushy seedbox (*Ludwigia alternifolia*), green parrotfeather (*Myriophyllum pinnatum*), pennyworts (*Hydrocotyle*), water lilies (*Nymphaea*), narrowleaf cattail (*Typha domingensis*), spiderworts (*Tradescantia*), and duckweeds (*Lemna*). Common halophytic herbs and shrubs found on the salty sands of the coast include spikesedges (*Eleocharis*), fimbries (*Fimbrystalis*), glassworts (*Salicornia*), sea-rockets (*Cakile*), maritime saltwort (*Batis maritima*), morning glories (*Ipomoea*), and bushy sea-ox-eye.

The low coastal marshes of the Gulf Prairies and Marshes vegetational area provide excellent habitat for upland game and waterfowl. Higher elevations of the marshes are used for livestock and wildlife production. These coastal marshes and barrier islands contain most of the State's National Seashore parks. Urban, industrial, and recreational developments have been increasing in this region and cultivation has never been of much importance due to the saline soils and recurrent flooding of the area. However, approximately one-third of the inland prairies region is cultivated. This is also the major area of irrigated crop production, consisting primarily of rice cultivation, for the entire Lower Colorado Region. Bermudagrass and several bluestem species are common in tamed pasturelands.

1.2.1.4 Water Resources[10, 11]

The primary surface water feature of Region K is the Colorado River. *Figure 1.10* displays the surface water hydrology characteristics of the region. The major sources of surface water supplies in the region are the Highland Lakes system and the run-of-the-river (ROR) water from the Colorado River. ROR water rights allow permit holders to divert water directly from a watercourse up to their permitted amounts if the water is present in the river and after senior priority rights are satisfied. Tributary ROR water rights and off-channel storage are also utilized by several water user groups (WUGs). In addition, a small portion of the planning region's surface water supply comes from local supplies within adjacent river basins. There are 16 water reservoirs within the Region K boundaries: Goldthwaite, Blanco, Llano (2), South Texas Project Nuclear Operating Company (STPNOC), and Cedar Creek reservoirs, Lake Bastrop, Lady Bird Lake, Lake Walter E. Long, the Highland Lakes system (Lakes Buchanan, Inks, LBJ, Marble Falls, Travis, and Austin), and the new Arbuckle Reservoir. The major Colorado River ROR water rights holders (based on firm yield) in Region K are the Lower Colorado River Authority (LCRA), City of Austin (COA), and STP Nuclear Operating Company. The City of Corpus Christi, located in Region N, and the Colorado River Municipal Water District, located in Region F immediately upstream of Region K, are also major water right holders on the Colorado River. Region K also has many springs, which are the transition from groundwater to surface water. Overall, there are approximately 43 major and significant springs in Region K, with 19 of those in San Saba County. Other counties with significant springs include Bastrop, Blanco, Burnet, Fayette, Gillespie, Hays, Llano, and Travis. For more information on the springs within Region K,

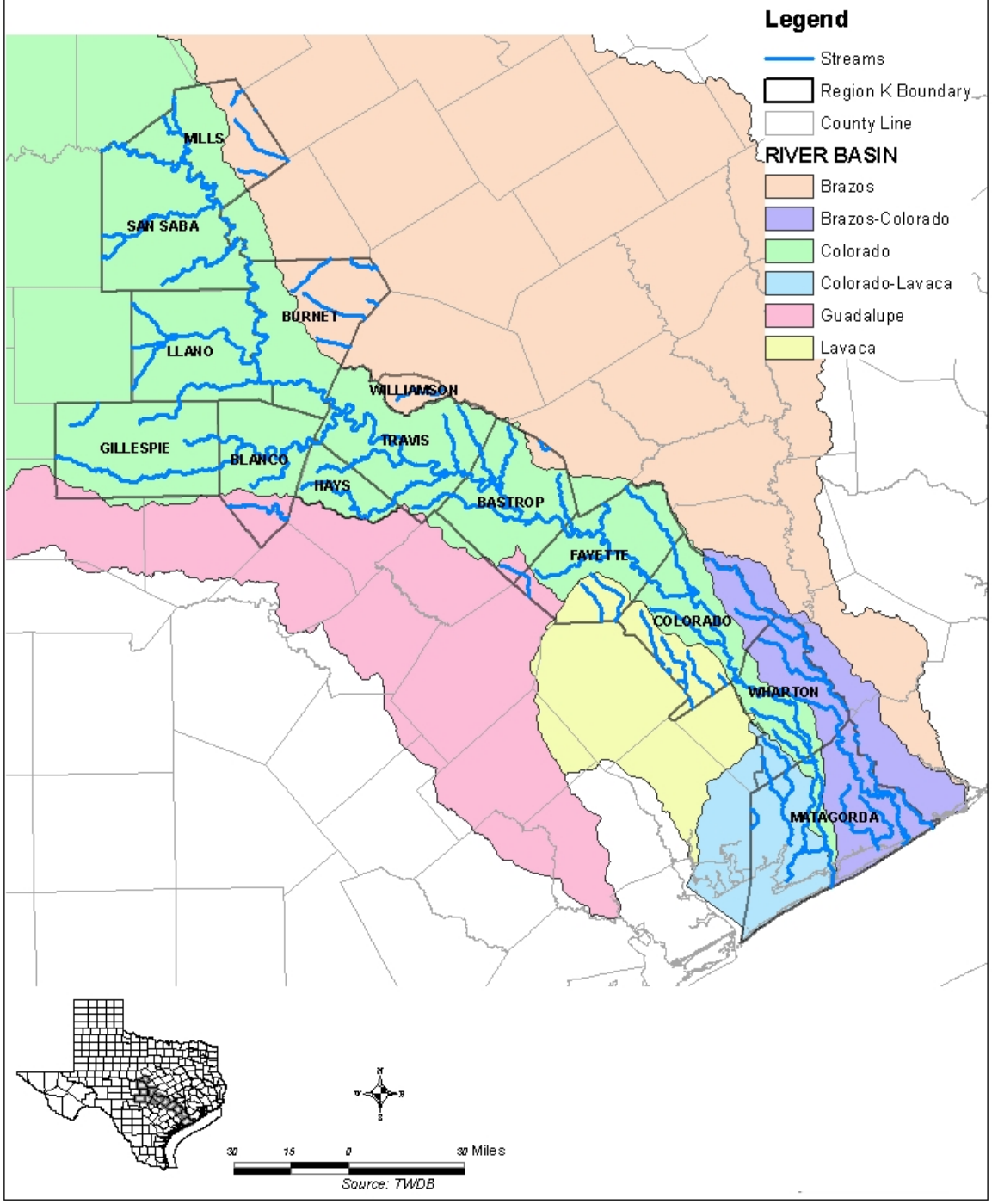
[10] Dallas Morning News, 1999. *Texas Almanac 2000-2001, 60th Edition*, Texas A&M Press.
[11] Texas Water Development Board (TWDB), November 1995. *Aquifers of Texas, Report 345*.

please refer to *Texas Water Development Board Report 189: Major and Historical Springs of Texas*, *by Gunnar Brune, March 1975*.

Large quantities of fresh to slightly saline groundwater underlie more than 81 percent of the land in Texas. There are nine "major" aquifers that can produce large quantities of fresh water over a large area, and 21 "minor" aquifers that yield smaller amounts of fresh water over smaller geographic areas. At present, approximately 60 percent of the annual water consumption in the state is derived from the major and minor aquifers in Texas, 75 percent of which is used for irrigation. Of these 30 aquifers, five major and six minor aquifers occur within Region K. The five major aquifers are the Carrizo-Wilcox, Edwards (Balcones Fault Zone [BFZ]), Edwards-Trinity (Plateau), Gulf Coast, and Trinity (*Figure 1.11*). These aquifers tend to run in curved belts northeast to southwest across the state. In Gillespie County, the Edwards-Trinity (Plateau) and Trinity aquifers have been determined to be undifferentiated for planning purposes and have been combined into one aquifer in this plan, referred to as the Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifer. More information on this aquifer is provided in Chapter 3.

The northern most major aquifer in Region K is the Trinity, which has both unconfined water-table and pressurized artesian zones, and covers portions of Mills, Burnet, Gillespie, Blanco, Travis, Hays, and Bastrop Counties. Within the region, the Trinity aquifer contains two major early Cretaceous age formations: the Antlers formation, which consists of a maximum of 900 feet of sand and gravel, with clay beds in the middle section; and the Travis Peak formation, which contains calcareous sands and silts, conglomerates, and limestones. West of the Trinity aquifer in Gillespie County is a small eastern water-table portion of the Edwards-Trinity (Plateau) aquifer. Within the planning region, the Edwards-Trinity (Plateau) aquifer contains saturated sediments of lower Cretaceous age formations and overlying limestones and dolomites. Maximum saturated thickness of the aquifer is 800 feet; however, the eastern portion of the aquifer in Gillespie County is thinner. Overlying a portion of the Trinity artesian zone is the Edwards (BFZ) aquifer, which covers portions of Hays, Travis, and Williamson Counties within Region K. In this area, the aquifer contains both unconfined and artesian zones and feeds the well-known recreational Barton Springs, which contributes an estimated average of 50 cubic feet per second (cfs) of flow to the Colorado River. The Edwards BFZ is primarily composed of early Cretaceous age limestone deposits that have a thickness ranging between 200 feet and 600 feet. This aquifer has a high permeability and transmissivity, making it heavily dependent on consistent recharge and extremely sensitive to environmental stresses. Southeast of the Trinity is the Carrizo-Wilcox aquifer in portions of Bastrop and Fayette Counties. This aquifer contains both water-table and artesian zones and consists of two hydrologically connected formations, the Wilcox Group and the overlying Carrizo formation, which are predominantly composed of Tertiary age sand that is imbedded with gravel, silt, clay, and lignite. The thickness of the artesian zone ranges from 200 feet to 3,000 feet. The southernmost and largest major aquifer within Region K is the Gulf Coast aquifer, which stretches continuously from southeastern Fayette County through Matagorda County. This portion of the aquifer is described as a leaky artesian system, which is composed of Cenozoic age complex interbedded clays, silts, sands, and gravel. In some areas near the Gulf Coast, heavy pumping has caused the intrusion of saltwater into aquifer layers that previously had good water quality. The physical characteristics of this aquifer make it susceptible to dewatering, or a permanent compaction of the clay layer and loss of water storage capacity, as a result of overuse of the aquifer. This compaction can also cause subsidence of surface land overlying the aquifer, which can contribute to flood and structural damage in the area.

Figure 1.10: Lower Colorado Regional Water Planning Area (Region K) Surface Water Hydrology



The minor aquifers occurring within Region K are the Ellenburger-San Saba, Hickory, Marble Falls, Queen City, Sparta, and Yegua-Jackson (*Figure 1.12*). All six of these aquifers contain unconfined zones and pressurized artesian zones. The Ellenburger-San Saba, Hickory, and Marble Falls aquifers occur in the northwestern portion of the planning region, have discontinuous circular coverage areas, and overlap one another. The Hickory aquifer is composed of the Hickory Sandstone Member of the Cambrian Riley formation, which contains some of the oldest sedimentary rocks found in Texas. This aquifer has a maximum thickness of 480 feet. The Ellenburger-San Saba aquifer has the same general shape as the Hickory and is composed of late Cambrian age limestone and dolomite. San Saba Springs is thought to be supplied primarily by the Ellenburger-San Saba and Marble Falls aquifers, which may be hydrologically connected in some areas. The Marble Falls aquifer occurs in several disconnected outcrops of Pennsylvanian age limestone that form fractures, solution cavities, and channels. The maximum thickness of this aquifer is 600 feet. Numerous large springs are fed by the Marble Falls aquifer, which provide a substantial portion of baseflow to the San Saba and Colorado Rivers in San Saba County. The Queen City, Sparta, and Yegua-Jackson aquifers overlap one another across southeastern Bastrop and northwestern Fayette Counties. The Queen City aquifer is composed of Tertiary age sand, loosely cemented sandstone, and interbedded clay. The maximum thickness of this aquifer is less than 500 feet. The Sparta aquifer overlies the downdip portion of the Queen City aquifer and consists of Tertiary age sand and interbedded clay. The Yegua-Jackson aquifer consists of interbedded sands, silts, and clays.

Surface water and groundwater supply availabilities for Region K are discussed in *Chapter 3* of this report.

Figure 1.11: Lower Colorado Regional Water Planning Area (Region K) Major Aquifers

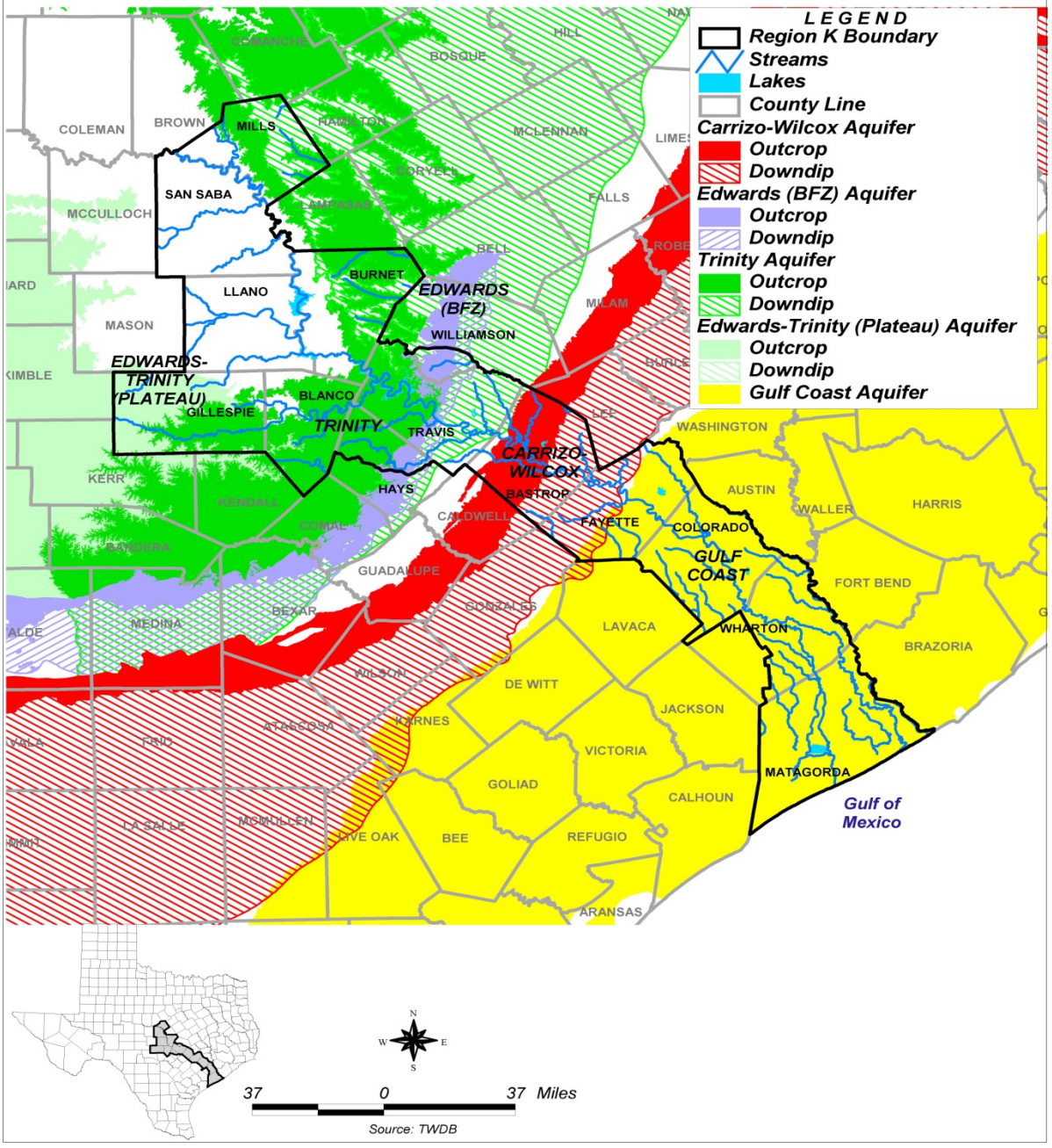
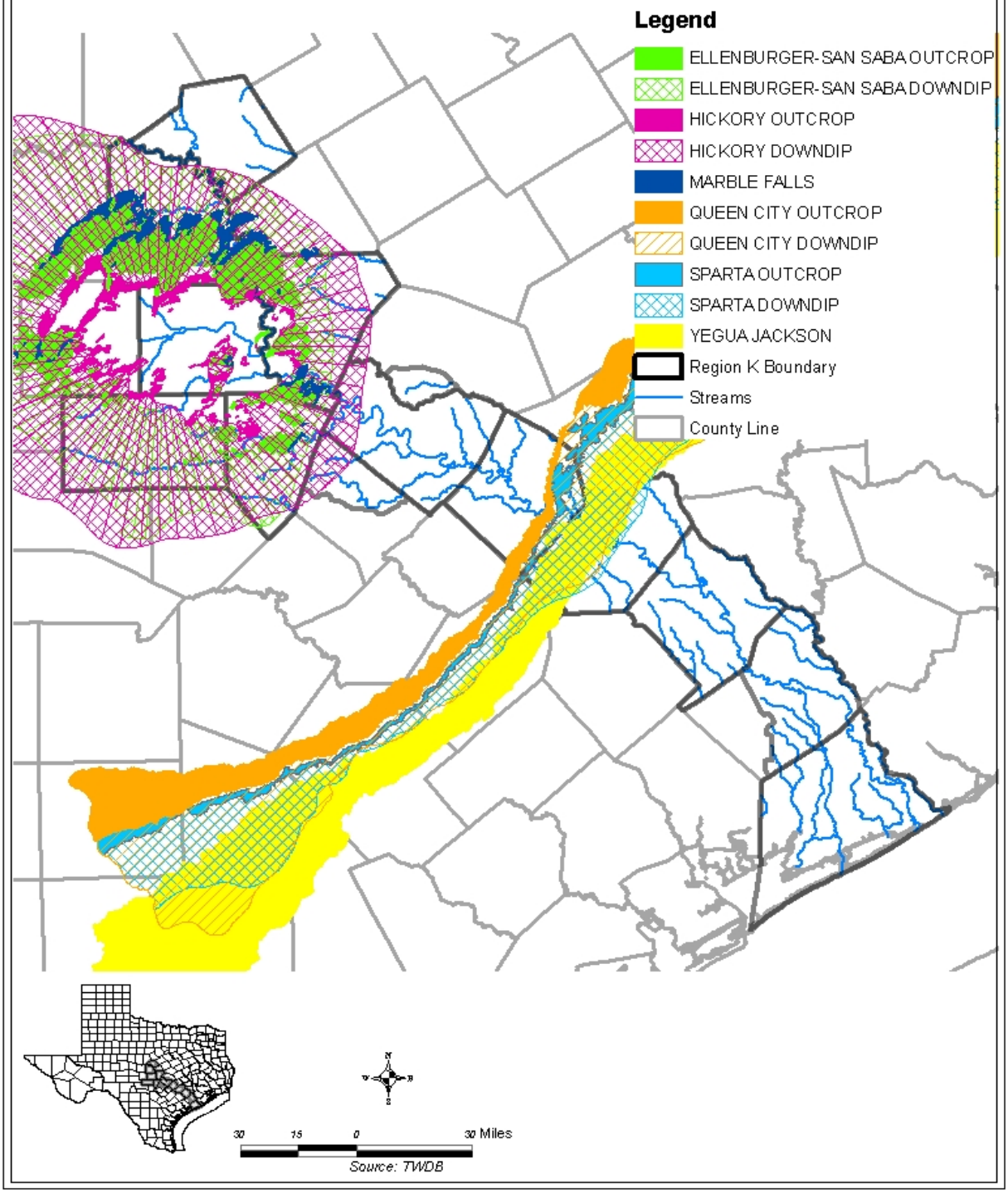


Figure 1.12: Lower Colorado Regional Water Planning Area (Region K) Minor Aquifers



1.2.1.5 Land Resources [12]

The majority of Region K falls within the Colorado River Basin and 91 percent of the region's population resides in this portion of the basin. Land use (*Figure 1.13*) in Region K consists primarily of agricultural land in Matagorda, Wharton, Colorado, Fayette, and eastern Travis Counties. Forestland runs through the middle of Colorado and Fayette Counties; western Travis and Burnet Counties; southeastern Llano County; and a significant portion of Gillespie and Hays Counties. Shrub/scrub and grassland predominates in Mills, San Saba, northwestern Llano, and eastern Burnet Counties. Blanco County is primarily a mixture of forestland and rangeland. Bastrop County is a mixture of forestland, agricultural land, and rangeland. A significant concentration of urban land only occurs in the Austin metropolitan area.

The State of Texas has 119 state parks, state historic sites, and state natural areas. Eleven (11) of these, with a total of 23,225 acres, occur within the counties of Region K (*Table 1.2*). The Texas State Park System offers a variety of recreational and educational opportunities, including camping, hiking, fishing, boating, water skiing, swimming, wildlife viewing, picnicking, and tours of nature exhibits and historical sites.

1.2.1.6 Wildlife Resources [13]

There are 19 national wildlife refuges in Texas, and four of these occur within Region K. Refuges function to preserve and protect critical wildlife habitat for unique, rare, threatened, and/or endangered species. Many refuges allow bird and wildlife viewing, hunting, and fishing during specific times of the year. In addition, the Texas Parks & Wildlife Department (TPWD) currently manages 52 Wildlife Management Areas (WMAs) in the state with a total of 756,464 acres. Two WMAs lie within Region K and encompass approximately 7,500 acres. These areas preserve and manage quality wildlife habitat and can allow compatible activities such as research, hunting, fishing, hiking, camping, bicycling, and horseback riding. *Table 1.3* lists the wildlife refuges and management areas within Region K.

Region K hosts a diversity of plant and animal wildlife species. In addition to the more commonly found species, each county within Region K provides habitat for several threatened or endangered animal and plant species. Endangered species are those at risk of extinction. Threatened species are those likely to become endangered in the future. These designations are made at the state and federal level by the TPWD and the U.S. Fish and Wildlife Service (USFWS). State and federal threatened and endangered species listings for each county in Region K are presented in *Appendix 1A*. Rare species that are not listed as threatened or endangered are also included.

[12] Texas Parks & Wildlife, May 2018.
[13] U.S. Fish & Wildlife Service, May 2018.

Table 1.2: State Parks Located Within the Lower Colorado Region

Name	County	Acreage	Description
Bastrop State Park	Bastrop	6,600	Established between 1933 and 1935 and contains the "Lost Pines" isolated region of loblolly pine and hardwoods. The Bastrop County Complex fire in September 2011 affected 96 percent of the park, including significant impact to the Lost Pines ecosystem and the loblolly pines.
Blanco State Park	Blanco	105	Established in 1933 along the Blanco River and has fishing for winter rainbow trout, perch, catfish, and bass.
Buescher State Park	Bastrop	1,017	Established between 1933 and 1936 and was part of Stephen F. Austin's colonial grant; an estimated 250 species of birds can be found in the park.
Colorado Bend State Park	San Saba	5,328	Established in 1984 and part is in Lampasas Co.; contains scenic Gorman Falls and is home to rare and endangered species including the bald eagle, golden-cheeked warbler, and black-capped vireo.
Enchanted Rock State Natural Area	Gillespie and Llano	1,644	Established in 1978 along Big Sandy Creek and contains a large granite outcrop that is the second largest batholith in the U.S. Enchanted Rock is also a national natural landmark and a national historic site.
Inks Lake State Park	Burnet	1,200	Established in 1940 along Inks Lake.
Longhorn Cavern State Park	Burnet	646	Established between 1932 and 1937 and was dedicated as a natural landmark in 1971. The cave has been used as a shelter since prehistoric times.
LBJ State Park & Historic Site	Gillespie	718	Established in 1965 along the banks of the Pedernales River; contains LBJ's home and a portion of the official Texas Longhorn herd, as well as bison, deer, and wild turkey; living-history demonstrations at the restored Sauer-Beckmann house.
McKinney Falls State Park	Travis	715	Established in 1976.
Monument Hill & Kreische Brewery State Historic Sites	Fayette	40	Established in 1907/1977. Memorial to the Salado Creek Battle in 1842 and the "black bean lottery" of the Mier Expedition; and one of the first breweries in the state.
Pedernales Falls State Park	Blanco	5,212	Established in 1970 and has typical Edwards Plateau terrain with live oaks, deer, turkey, and stone hills.

Figure 1.13: Lower Colorado Regional Water Planning Area (Region K) Land Use Distribution

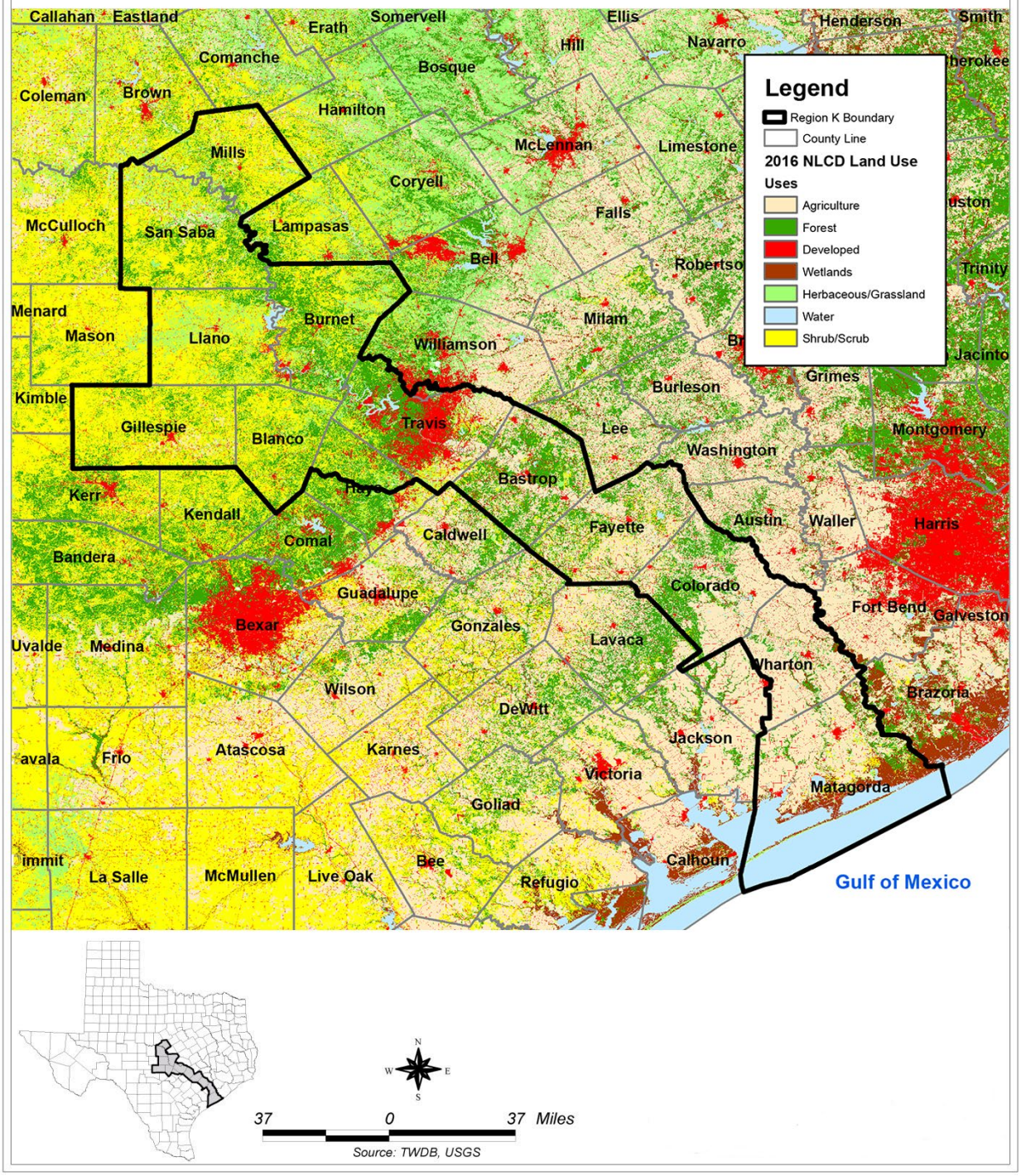


Table 1.3: Wildlife Refuges/Management Areas Located Within the Lower Colorado Region

Name	County	Acreage	Description
National Wildlife Refuges			
Attwater Prairie Chicken[1]	Colorado	10,541	Established in 1972 to preserve habitat for the endangered Attwater Prairie Chicken, which includes native tallgrass prairie, potholes, sandy knolls, marshes, and some wooded areas.
Balcones Canyonlands[2]	Travis	27,500	Established in 1992 northwest of Austin to protect the nesting habitat of two endangered bird species: golden-cheeked warbler and the black-capped vireo.
Big Boggy[3]	Matagorda	4,526	Established in 1983 along the coast of Texas in southeastern Matagorda County to conserve key coastal wetlands for Neotropical migratory birds and shorebirds in spring and fall, as well as for wintering fowl and year-round wildlife.
San Bernard[4]	Matagorda	54,000	Established in 1968 near Freeport which attracts white-fronted and Canada geese and several species of duck.
Wildlife Management Areas			
Mad Island[5]	Matagorda	7,200	This area allows scheduled hunting and wildlife viewing.
D. R. Wintermann WMA[6]	Wharton	246	This area has limited access.

[1] U.S. Fish & Wildlife Service (URL: http://www.fws.gov/refuge/attwater_prairie_chicken/faqs.html)
[2] Balcones Canyonlands National Wildlife Refuge (URL: https://www.fws.gov/nwrs/threecolumn.aspx?id=46233)
[3] Big Boggy National Wildlife Refuge (URL: https://www.fws.gov/refuge/Big_Boggy/about.html)
[4] U.S. Fish & Wildlife Service (URL: http://www.fws.gov/refuge/San_Bernard/faqs.html)
[5] Texas Parks & Wildlife (URL: https://tpwd.texas.gov/huntwild/hunt/wma/find_a_wma/list/?id=39)
[6] Texas Parks & Wildlife (URL: http://www.tpwd.state.tx.us/huntwild/hunt/wma/find_a_wma/list/?id=44)

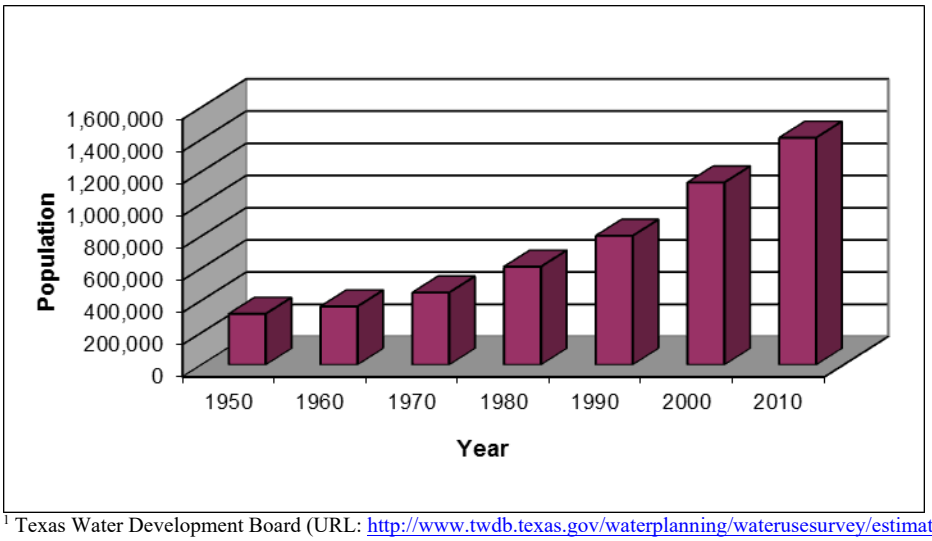
1.2.2 Socioeconomic Characteristics of the Lower Colorado Regional Water Planning Area

1.2.2.1 Historic and Current Population Trends[14]

Region K has had a steady increase in population from 1950 to the present. As *Figure 1.14* shows, in 1950 there were approximately 316,573 people, which has increased to an estimated 1,410,328 people in 2010. This corresponds to an overall 345 percent increase in the number of people living in the region during that time period. The period from 1990 to 2000 had the largest percent increase of almost 41 percent, or an addition of 331,199 people. The time period of smallest population growth occurred between 1950 and 1960, with an increase of 45,830 persons (14.5 percent). As discussed in *Chapter 2*, this growth trend is expected to continue for the entire State of Texas, as well as Region K. For the period 2020 to 2070, a compound annual growth rate of 1.26 percent is projected, resulting in a total regional population of 3,290,477 in 2070.

[14] Bureau of the Census, Decadal Censuses of 1950, 1960, 1970, 1980, 1990 and 2000; and Region K historic population data supplied by the Texas Water Development Board for 1980–2010. The Region K 2020 Population projections were developed utilizing year 2010 census data as a starting point with adjustments made by the LCRWPG as necessary. Populations for the partial Region K counties of Hays, Williamson, and Wharton were estimated by determining the percent decreases observed in projections from the U.S. Census and the TWDB for 1980 and 1990; these percent decreases were then averaged and applied to the 1950, 1960, and 1970 U.S. Census partial-county populations.

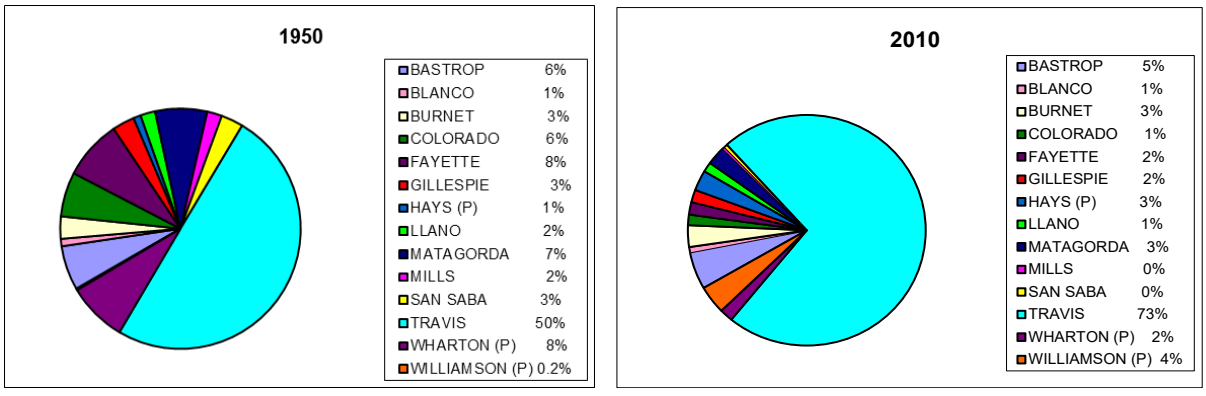
Figure 1.14: Historic Lower Colorado Regional Water Planning Area Population[1]



[1] Texas Water Development Board (URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp) (Water Planning. County Summary, 2000 and Later)

Comparison of the region's county population distribution between 1950 and 2010 (*Figure 1.15*) shows that Travis County contains the majority of the region's population. Travis County's proportion of population compared to the region has increased from 50 percent in 1950 to 73 percent in 2010 due to the rapid growth of the Austin area. Travis County's population has increased more than 500 percent between 1950 and 2010, with the addition of over 800,000 people. Hays County has also seen a large population increase with over twelve times as many people living in the county in 2010 as in 1950. The Region K portion of Williamson County has shown an even larger percent increase in population as well, with a 2010 population 85 times the size of the 1950 population. Other counties in the region have experienced much smaller growth rates, historically.

Figure 1.15: Lower Colorado Region County Population Distribution[1]



[1] Texas Water Development Board (URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp) (Water Planning. County Summary, 2000 and Later)

Recent population growth, since the year 2000, of the Austin metropolitan area has expanded from Travis County into Bastrop County, Hays County, and Williamson County. With the construction of the SH 130 and SH 45 corridors in Travis County, travel between counties has become easier and thus is facilitating increased population growth within a larger radius of the City of Austin. Increased development

surrounding the corridors is projected to continue for the next several decades. Areas surrounding the Highland Lakes are also seeing larger increases in population growth, specifically Burnet County and Llano County.

1.2.2.2 Primary Economic Activities[15, 16]

Economic activities in Region K include agriculture, government/services, manufacturing, mining, tourism, and trades. *Table 1.4* lists the primary economic base of each county as well as the breakdown of mining and agricultural activities.

Table 1.4: Lower Colorado Region Primary Economic Activities by County

County	Primary Economic Base	Mineral Deposits	Agriculture
Bastrop	government/services, tourism, agribusiness, bio-technology research, computer-related industries, commuters to Austin	clay, lignite	hay, beef cattle, nursery/turf grass, pecans, vegetables, pine, oak
Blanco	tourism, agribusiness/nursery, ranch supplies, hunting/fishing	insignificant	cattle, sheep, goats, hay, vegetables, peaches, grapes, pecans, greenhouse nurseries
Burnet	tourism, stone processing, hunting	granite, limestone	cattle, goats, grapes, hay, hunting
Colorado	agribusiness, oil and gas services, gravel mining	gas, oil, gravel	rice, cattle, corn, cotton, soybeans, sesame, hay, pecans, nurseries
Fayette	agribusiness, electrical power generation, mineral production, small manufacturing, government/services, tourism	oil, gas, sand, gravel, bentonite, clay	beef cattle, corn, sorghum, peanuts, hay, pecans, dairies
Gillespie	tourism, government/services, agriculture, wine and specialty foods, hunting	sand, gravel	beef cattle, wine, hay, peaches, hunting
Hays (p)	education, tourism, retirement, some manufacturing	sand, gravel, cement	beef cattle, goats, exotic wildlife, greenhouse nurseries, hay, corn, sorghum, wheat, cotton
Llano	tourism, retirement, ranch trading center, vineyards	granite, vermiculite, llanite	beef cattle, sheep, goats
Matagorda	nuclear power plant, petrochemicals, agribusiness	gas, oil	cattle, rice, cotton, sorghum, soybeans, aquaculture
Mills	agribusiness, hunting	insignificant	beef cattle, dairies, sheep, goats, hay
San Saba	pecan processing plants, tourism, hunting	limestone, sand stone	cattle, sheep, goats, pecans, wheat, hay, hunting
Travis	government/services, education, technology, research and industry	lime, stone, sand, gravel, oil, gas	cattle, nursery crops, hogs, sorghum, corn, cotton, small grains, pecans
Wharton (p)	oil, agribusiness, hunting, varied manufacturing, government/services	oil, gas	leading rice producing county, cotton, milo, corn, sorghum, soybeans, turf grass, eggs, cattle, aquaculture
Williamson (p)	agribusiness, varied manufacturing, government/services, education center	building stone, sand, gravel	beef cattle, sorghum, cotton, corn, wheat, hay, nursery crops

(p) - a portion of the county lies within the Region K boundaries

Agriculture plays a major role in most of the counties in Region K. Livestock accounts for a significant portion of the planning region's agricultural cash receipts and important crops include rice, hay, wheat, and cotton. The counties located in the northwestern portion of the planning region depend heavily on livestock

[15] Texas State Historical Association (Texas Almanac 2018-2019).
[16] Texas Comptroller of Public Accounts, Texas Economy.

production. Rice is the major crop produced in the southernmost counties of Colorado, Wharton, and Matagorda.

The manufacturing sector consists primarily of the technology and semiconductor industries, in the mid-region counties of Bastrop, Travis, and Williamson. The largest single manufacturing industry in the coastal counties is petroleum refining and petrochemicals. Electrical generation is a notable industry in Matagorda County. The South Texas Project Electric Generating Station provides generation capacity to serve more than 2 million homes as well as being the largest employer and source of revenue for the county. At the same time, there has been significant economic growth in food processing, lumber, wood products, and construction supplies for the coastal counties. The tourism industry represents an important economic sector that is heavily dependent on water resources in Llano, Burnet, and Travis Counties. *Appendix 1B* includes background information on the history and social and economic importance of the Highland Lakes, as provided by a stakeholder interest group within Region K.

Population and economic estimates are presented in *Table 1.5* for the Lower Colorado Region by county.

Table 1.5: Lower Colorado Region County Population and Economic Estimates

County Name	2016 Resident Population [1]	Per Capita (2016 dollars) Personal Income [1]		CY 2012-2016	CY 2012-2016 Poverty [2]	2018 Average Labor Force Employment and Unemployment [3]			
		Per Capita ($)	Total (millions $)	Median Household Income ($)[2]	Poverty Rate (%)	Labor Force	Persons Employed	Persons Un-employed	Unemploy-ment Rate (%)
Bastrop	78,286	$25,379	$1,987	$55,808	13.6	41,612	40,064	1,548	3.7
Blanco	10,918	$30,982	$338	$56,573	9.7	6,513	6,338	175	2.7
Burnet	44,584	$27,434	$1,223	$54,259	14.4	22,619	21,902	717	3.2
Colorado	20,792	$26,161	$544	$45,398	14.0	10,407	10,047	360	3.5
Fayette	24,909	$28,665	$714	$51,290	10.8	12,875	12,480	395	3.1
Gillespie	25,732	$30,939	$796	$55,850	10.8	13,769	13,401	368	2.7
Hays	185,686	$28,396	$5,273	$60,495	16.2	111,548	108,107	3,441	3.1
Llano	19,624	$34,633	$680	$48,562	13.8	8,520	8,187	333	3.9
Matagorda	36,719	$22,939	$842	$41,253	21.7	17,566	16,444	1,122	6.4
Mills	4,871	$24,099	$117	$44,375	14.5	1,968	1,895	73	3.7
San Saba	5,881	$19,583	$115	$40,718	18.0	2,466	2,381	85	3.4
Travis	1,148,176	$36,649	$42,080	$64,422	15.2	722,202	700,641	21,561	3.0
Wharton	41,377	$23,245	$962	$46,445	17.7	21,485	20,637	848	3.9
Williamson	490,619	$32,705	$16,046	$75,935	7.2	296,417	286,940	9,477	3.2
Region K [4]	2,138,174	$33,541	$71,717	-	-	1,289,967	1,249,464	40,503	3.5
Texas	26,956,435	$27,828	$750,144	$54,727	16.7	13,834,783	13,265,346	569,437	4.1

[1] U.S. Bureau of the Census (URL: http://factfinder2.census.gov) (2012-2016 American Community Survey 5-Year Estimates)
[2] U.S. Bureau of the Census (URL: http://quickfacts.census.gov) (State & County QuickFacts profiles.)
[3] Texas Workforce Commission (URL: http://www.tracer2.com/)
[4] Includes all of Hays, Wharton, and Williamson Counties.

Table 1.6 summarizes 2012 payroll data for Region K by county and economic sector.

Table 1.6: 2012 County Payroll by Category ($1,000)[1]

Category	Bastrop	Blanco	Burnet	Colorado	Fayette	Gillespie	Hays
Accommodation & Food Services	$39,815	$3,567	$25,630	$7,427	$11,819	$22,854	$99,301
Admin, Support, Waste Mgmt, Remediation Services	$4,527	$1,328	$17,292	$3,402	$833	$6,224	$45,288
Arts, Entertainment & Recreation	(D)	$55	$7,530	$2,163	$1,271	$2,424	$6,508
Educational Services	$719	(D)	$355	(D)	(D)	(D)	$3,696
Finance and Insurance	$13,807	(D)	$17,417	$6,834	$11,767	$14,727	$46,065
Health Care & Social Assistance	$62,702	$3,627	$51,470	$37,665	$23,270	$66,449	$220,842
Information	$2,017	$592	$6,727	$1,587	$4,008	$2,782	$34,450
Manufacturing	$41,966	$4,570	$33,205	$78,712	$38,571	$20,690	$203,863
Other Services	$8,582	$1,437	$6,904	$2,835	$6,847	$6,373	$35,250
Professional, Scientific and Technical Services	$14,617	(D)	$14,628	$3,459	$7,030	(D)	$77,709
Real Estate, Rental, and Leasing	$3,734	$238	$5,184	$7,856	$3,323	$6,479	$21,604
Retail Trade	$59,649	$4,713	$52,108	$21,292	$28,547	$33,747	$208,397
Transportation and Warehousing	$6,749	$4,146	$3,136	(D)	$8,754	(D)	$59,862
Utilities	$13,552	(D)	(D)	(D)	(D)	(D)	$12,732
Wholesale Trade	(D)	(D)	$14,750	$9,692	(D)	(D)	(D)
Total Payroll	**$272,436**	**$24,273**	**$256,336**	**$182,924**	**$146,040**	**$182,749**	**$1,075,567**
Total Employees	**9,714**	**966**	**8,471**	**5,312**	**5,036**	**6,136**	**36,742**

[1] U.S. Bureau of the Census (URL: http://factfinder2.census.gov)
D = Data withheld to avoid disclosing data for individual companies

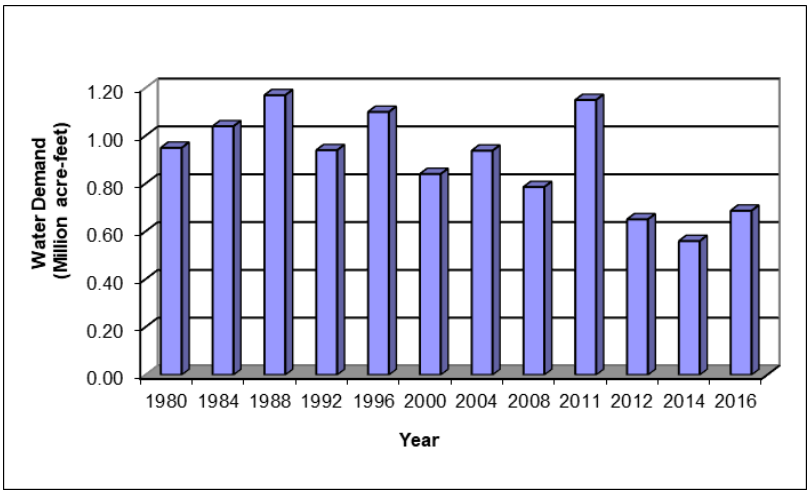
Table 1.6 (Continued): 2012 County Payroll by Category ($1,000) [1]

Category	Llano	Matagorda	Mills	San Saba	Travis	Wharton	Williamson
Accommodation & Food Services	$21,146	$13,958	$1,125	(D)	$1,032,987	$12,778	$224,230
Admin, Support, Waste Mgmt, Remediation Services	$2,156	$15,259	$235	(D)	$2,076,862	$5,837	$284,262
Arts, Entertainment & Recreation	(D)	$1,088	(D)	(N)	$202,882	$1,339	$48,220
Educational Services	(D)	(D)	(D)	(N)	$184,408	(D)	$9,946
Finance and Insurance	$6,208	$7,920	$1,904	(D)	$2,063,099	$17,990	$442,452
Health Care & Social Assistance	$19,347	$48,073	$3,723	$4,618	$2,731,107	$51,283	$721,784
Information	$410	$1,935	(D)	(D)	$2,018,316	$2,896	$247,822
Manufacturing	$2,307	$41,414	$1,628	$1,424	$1,501,102	$54,990	$386,137
Other Services	$1,671	$9,327	(D)	(D)	$703,658	$4,988	$121,987
Professional, Scientific and Technical Services	$3,865	$4,230	(D)	$1,161	$4,870,874	$9,615	$451,632
Real Estate, Rental, and Leasing	$1,447	$7,459	(D)	$62	$539,031	$7,529	$65,506
Retail Trade	$10,975	$25,703	$5,307	$3,727	$1,443,334	$49,104	$593,255
Transportation and Warehousing	$269	$11,017	$319	$755	$378,478	$17,506	$45,554
Utilities	(D)	(D)	(D)	(D)	$67,059	$5,341	$75,912
Wholesale Trade	$10,074	$4,514	(D)	$1,061	$1,470,861	$37,224	(D)
Total Payroll	**$79,875**	**$191,897**	**$14,241**	**$12,808**	**$21,284,058**	**$278,420**	**$3,718,699**
Total Employees	**2,901**	**5,844**	**604**	**545**	**433,674**	**9,682**	**98,062**

[1] U.S. Bureau of the Census (URL: http://factfinder2.census.gov)
D = Data withheld to avoid disclosing data for individual companies
N = Not Available or not comparable

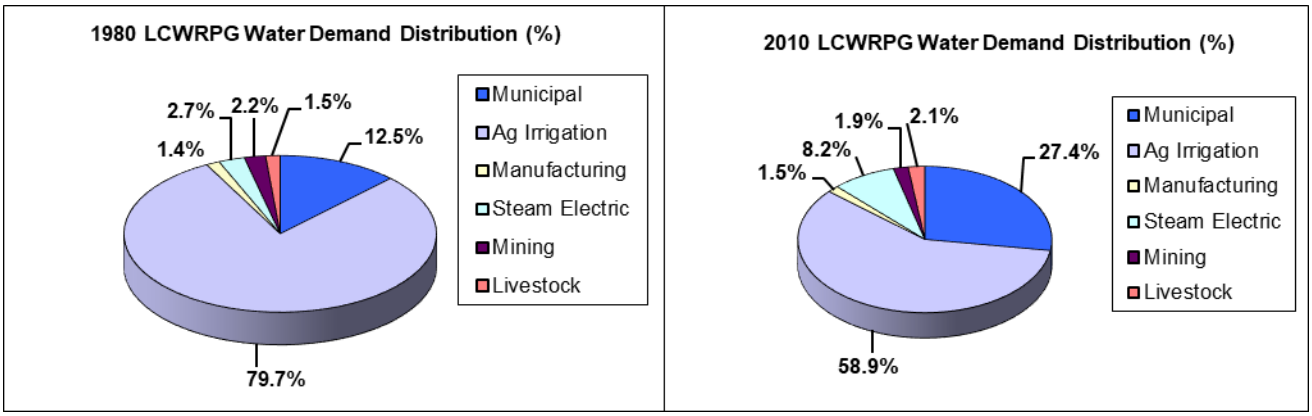
1.2.2.3 Historical Water Uses[17, 18]

Figure 1.16: Lower Colorado Regional Water Planning Area Historical Water Demand[17]



Total annual water use in the Lower Colorado Regional Planning Area has decreased approximately 18 percent from 1980 to 2016 (*Figure 1.16*). A peak water use of 1.17 million ac-ft occurred in 1988. Water demand in each year is impacted by many factors, including rainfall and can show fluctuation from year to year. For example, 2011 water use of 1.15 million ac-ft neared the 1988 peak use due to drought conditions with corresponding high municipal and agricultural irrigation use. In 2014, water use saw a low of 0.56 million ac-ft due mostly to emergency curtailment of agricultural irrigation and implementation of municipal drought contingency plans. Relative water use distribution, by water use category, has remained relatively similar between 1980 and 2010 (*Figure 1.17*). Agricultural irrigation is the largest water use in Region K, which accounted for almost 80 percent of water use in 1980 and 59 percent in 2010. Municipal has consistently been the second largest water use category since 1980, followed by steam-electric power, mining, manufacturing, and livestock water uses.

Figure 1.17: Lower Colorado Region User Group Water Demand Distribution[17, 18]



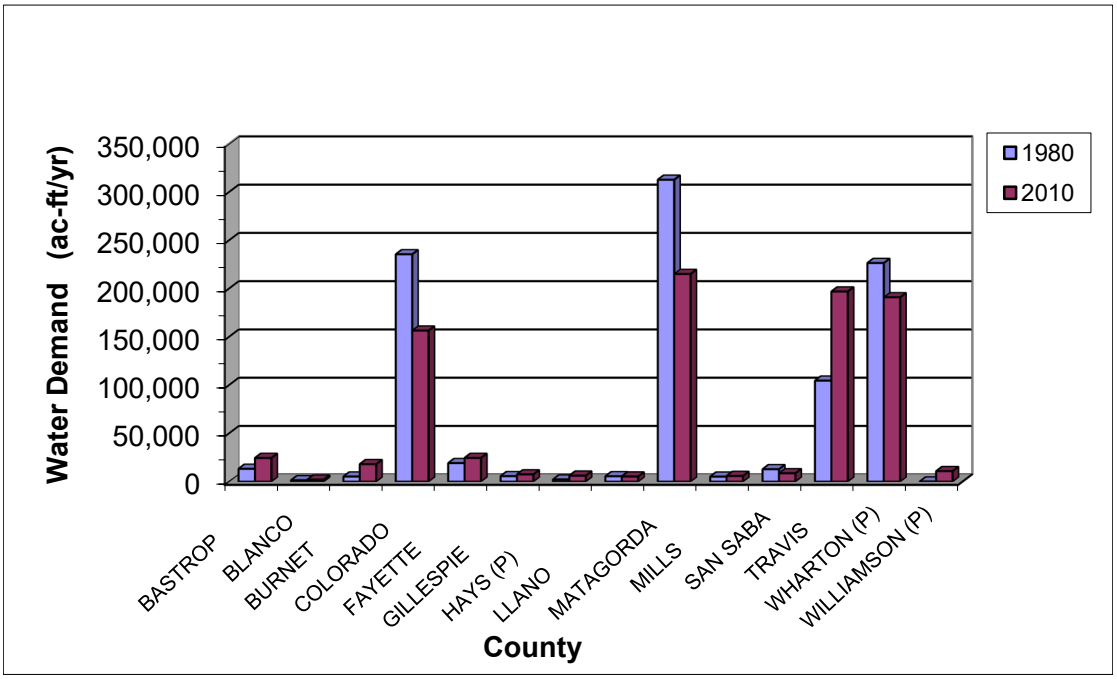
When comparing 1980 demands to 2010 demands, agricultural irrigation water demands show a 34 percent decrease, municipal demands show a 97 percent increase, livestock demands show 27 percent increase, mining demands show a 23 percent decrease, and manufacturing demands show a 6 percent decrease. Steam-electric power generation shows the largest water demand increase of 171 percent.

The water demand distribution between the 14 counties in Region K shows that when comparing water demands for 1980 and 2010, demand was consistently the greatest in Matagorda County, which accounted

[17] Texas Water Development Board (URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp) (Water Planning. State/Planning Region (map))
[18] Texas Water Development Board (URL: http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp) (Water Planning. County Summary, 2000 and Later)

for approximately 33 percent of the region's total water demand in 1980 and 25 percent in 2010 (*Figure 1.18*). The major water use in Matagorda County is rice irrigation. Colorado and Wharton Counties are among the largest water users in the region, which is also attributed to the extensive rice irrigation in these counties. Travis County contains the region's only major municipal demand center, and its water use ranked fourth overall in 1980 and second overall in 2010. Overall, these four counties account for approximately 93 and 87 percent of the region's total water demand, respectively, for 1980 and 2010. Details of Region K's projected future water demands are presented in *Chapter 2*.

Figure 1.18: Lower Colorado Regional Water Planning Area County Water Demand Distribution[16, 17]

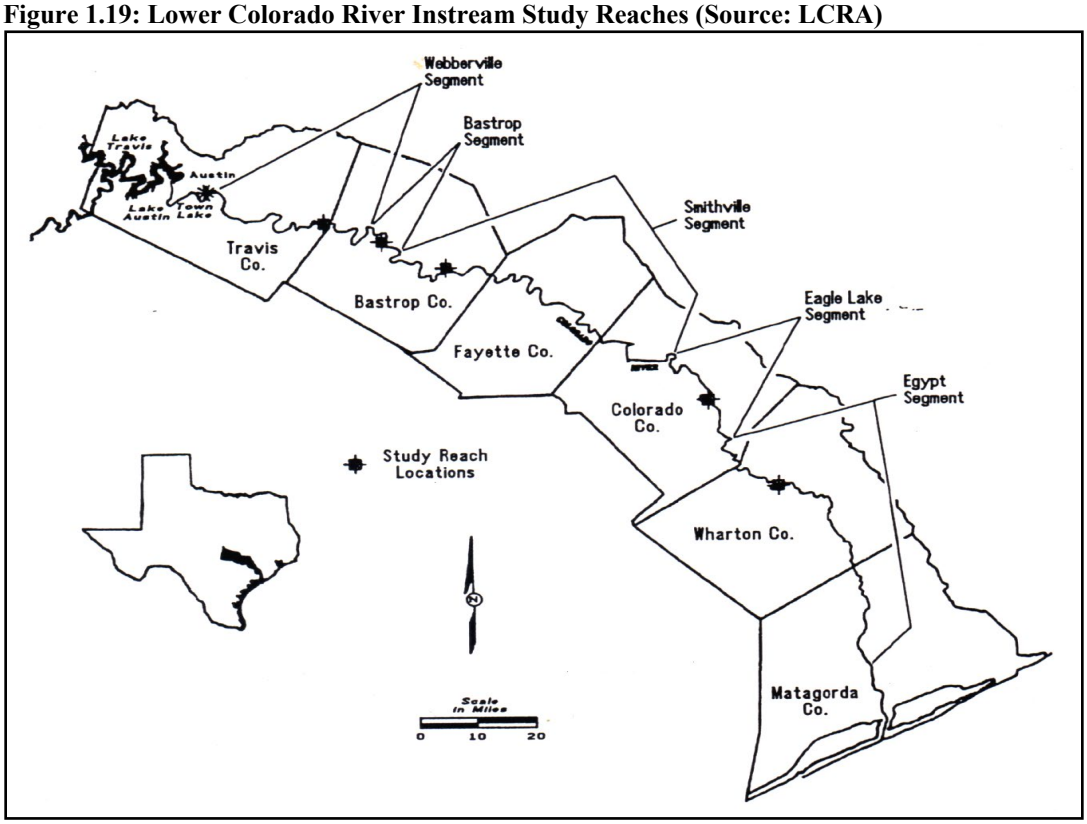


Water for the maintenance of important environmental instream flows and bay inflows is also a significant water use within the reaches of streams in Region K. Reaches above the Highland Lakes in San Saba and Mills Counties are dependent on rainfall, springflow and water releases from Stacy Dam at O.H. Ivie Reservoir, which is outside Region K and is under the control of the Colorado River Municipal Water District within Region F. Minimum continuous instream flow releases from Stacy Dam were required by the USFWS as a mitigation component to obtain a Section 404 permit from the U.S. Army Corps of Engineers (USACE) in order to build Stacy Dam.

A comprehensive instream flow study ("BIO-WEST, Inc. *Colorado River Flow Relationships to Aquatic Habitat and State Threatened Species: Blue Sucker, Final Report Prepared for LCRA and SAWS* (2008)") was completed in 2008 that recommended both subsistence flow conditions and base flow conditions, including base-dry and base-average conditions being met approximately 80% and 60% of the time, respectively. The TCEQ environmental flow standards for the Colorado River Basin are found in 30 TAC, 398 Subchapter D, and are largely based on the results of this study. The LCRA Water Management Plan is updated on an as-needed basis to reflect changing conditions in the basin. For reasons related to planning timelines, the version of the LCRA WMP that is used for the 2021 Region K Water Plan is the 2015 LCRA WMP. The latest update to the LCRA WMP was approved by the LCRA Board and submitted for approval

to the TCEQ in 2019 and was approved by TCEQ in early 2020. More details on the LCRA WMP are provided in *Chapter 2*.

Figure 1.19: Lower Colorado River Instream Study Reaches (Source: LCRA)



In accordance with its WMP, LCRA manages the lower Colorado river system to maintain instream flows at or above the minimum critical flow levels. Through its WMP, LCRA dedicates a portion of its firm supplies to support maintenance of subsistence or critical instream flows. Target instream flows are designed to provide an optimal range of habitat complexity to support a well-balanced, native aquatic community within a stream reach. *Chapter 2* provides extensive details on critical and target instream flow recommendations for the Lower Colorado River in *Section 2.4*.

Freshwater inflow is also essential for healthy coastal estuarine ecosystems along the Texas Coast. Ninety-seven percent of the fishery species (shellfish and finfish) in the Gulf of Mexico spend all or a portion of their life cycle in estuaries. The life cycles of estuarine-dependent species vary seasonally and have different migratory patterns between the estuary and the Gulf. The Matagorda Bay system is the second largest estuary in the state, and this system receives freshwater inflow from the Colorado River, the Lavaca River, and surface runoff from the contributing drainage basin areas. On average, the Matagorda Bay system annually receives more than 2.0 million ac-ft of fresh water from the Colorado River and basin. *Chapter 2* provides details on Bay and Estuary freshwater inflows for Matagorda Bay in *Section 2.4*.

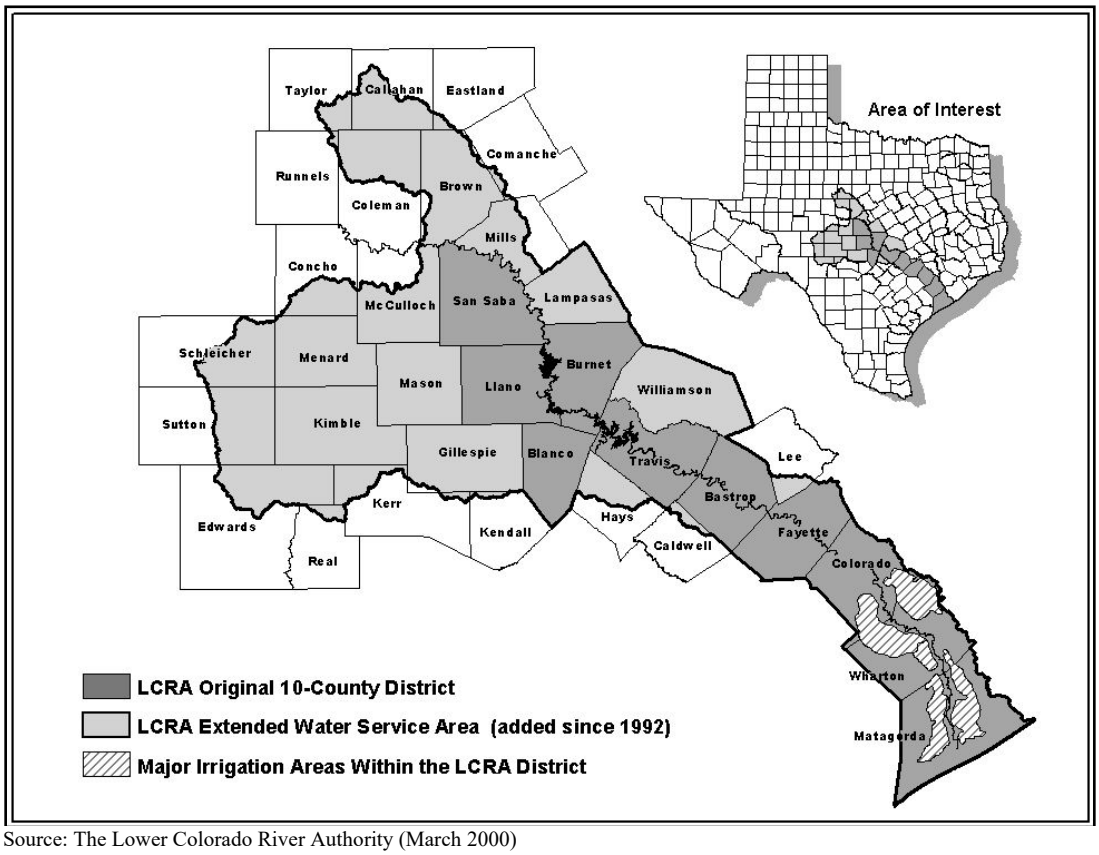
1.2.2.4 Major Water Providers

The TWDB guidelines allow each RWPG to identify and designate "major water provider(s)" for each region. A major water provider is defined as a Water User Group or a Wholesale Water Provider of

particular significance to the region's water supply as determined by the Regional Water Planning Group. A wholesale water provider is an entity "... which delivers and sells any amount of raw or treated water for municipal and/or manufacturing use on a wholesale basis." The intent of these TWDB guidelines is to ensure that there is an adequate future supply of water for each entity that receives all or a significant portion of its current water supply from another entity.

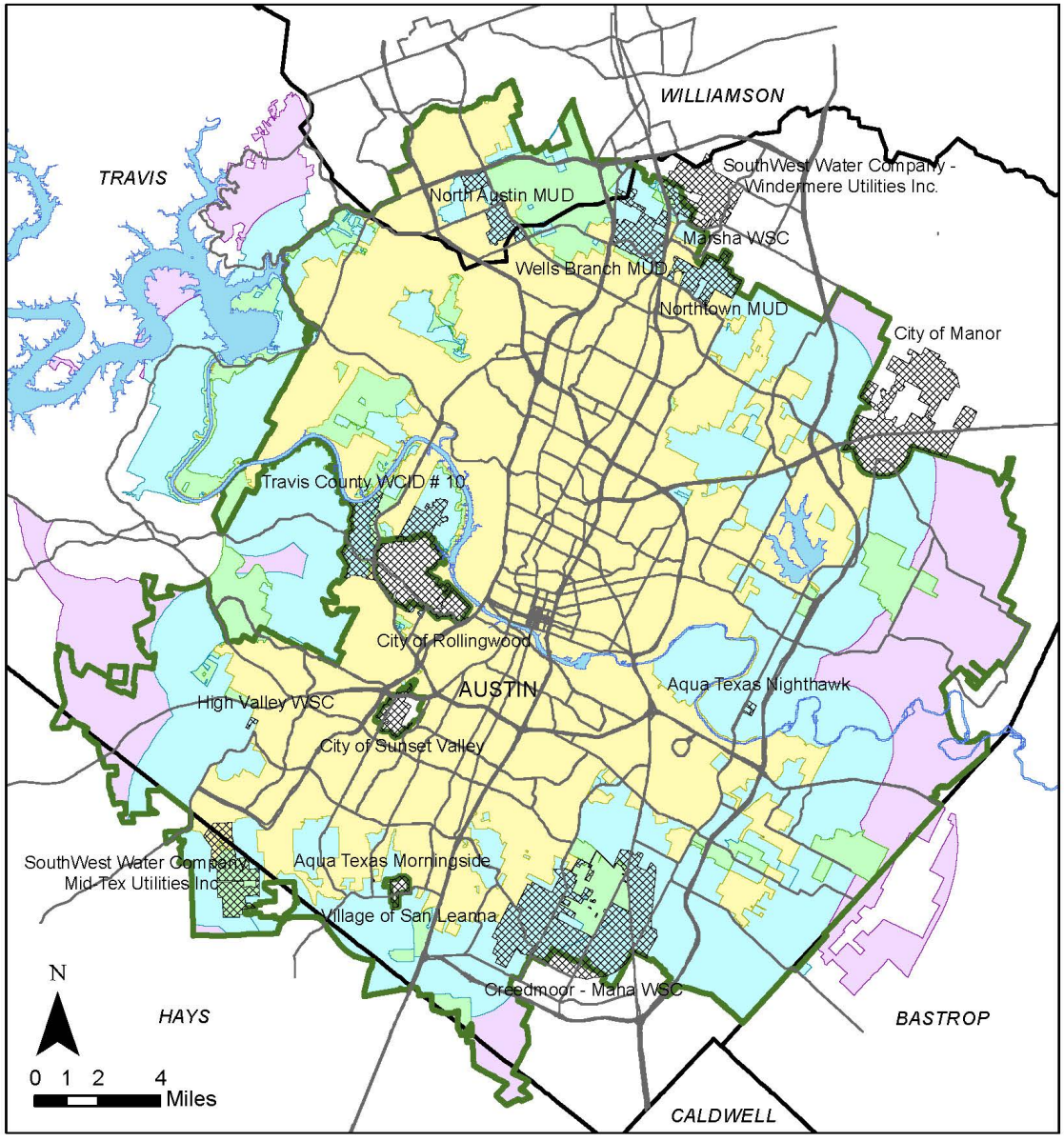
The LCRWPG has designated the LCRA, Austin, and West Travis County Public Utility Agency (WTCPUA) as major water providers. The LCRA provides water for municipal, agricultural (irrigation), manufacturing, steam-electric, mining and other uses within all or part of a 36-county service area. LCRA's current service area allows it to provide water to entities in each of the 14 counties within the Lower Colorado Regional Planning Area (*Figure 1.20*). Austin supplies water for municipal, manufacturing, and steam-electric uses. Austin's water planning area encompasses portions of Travis, Williamson, and Hays Counties (*Figure 1.21*). WTCPUA provides water to municipal Water User Groups in Hays County and Travis County.

Figure 1.20: Lower Colorado River Authority Water Supply Service Area



Source: The Lower Colorado River Authority (March 2000)

Figure 1.21: Austin Water Supply Service Area



Legend

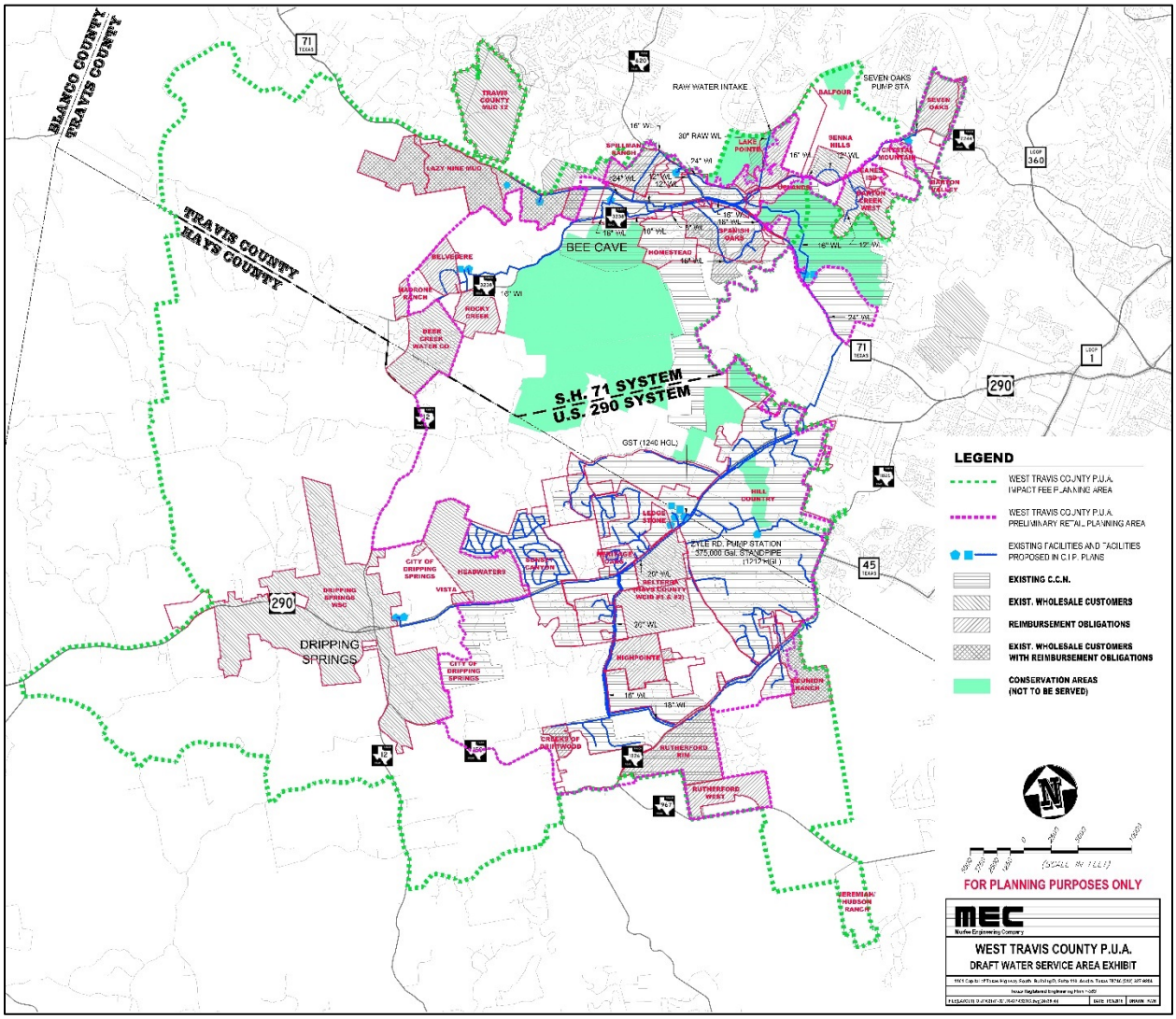
- Streets
- Wholesale Customers
- Impact Fee Boundary
- County Boundary
- Full-Purpose City Limit
- Limited-Purpose City Limit
- City of Austin 2 Mile ETJ
- City of Austin 5 Mile ETJ

City of Austin
Austin Water
November 2018

City of Austin
Major Water Provider Map

Produced by Systems Planning Division

Figure 1.22: West Travis County Public Utility Agency Service Area



1.2.3 Water Quality in the Colorado River Basin[19]

The chemical characteristics of and the State Water Quality Criteria assigned to the Colorado River vary along its length (900 river miles) from the upper basin that is mainly within the West Texas Regional Water Planning Area (Region F) to the mouth of the river at Matagorda Bay in the Lower Colorado Regional Planning Area (Region K) (*Table 1.7*). The water quality differences of the various stream segments of the Colorado River are due to variations in both natural and man-made influences affecting each segment's drainage area. In addition, water flowing from upstream segments of the Colorado River and its tributaries also contribute to each downstream segment's water quality characteristics.

The Colorado River is divided into 34 classified stream segments, the standards of which are defined by the Texas Commission on Environmental Quality (TCEQ) in TAC 307.3 as (65) Standards--Desirable uses (i.e., existing, attainable, designated, or presumed uses as defined in this section) and the narrative and numerical criteria deemed necessary to protect those uses in surface waters.

Approximately 19 of the Colorado River classified stream segments are located within Region K. A portion of these are tributaries of the Colorado River.

The Texas Natural Resource Conservation Commission (TNRCC), now known as TCEQ, initiated the Texas Clean Rivers Program (CRP) in 1991 to address the Texas Clean Rivers Act. The State Legislature passed this act in response to concerns within the state that water quality issues were being addressed in an uncoordinated fashion. The CRP established a watershed management approach to identify and evaluate water quality issues, as well as to set priorities for the improvement of water quality throughout the state. The CRP set up a partnership in each river basin that consisted of the TNRCC, other state agencies, river authorities, local governments, and private citizens. Each river basin was to provide the TNRCC with updated regional water quality data, and the TNRCC was required to summarize these basin-wide assessments into a statewide report every 2 years.

Currently, the Texas Integrated Report is prepared every two years and describes the status of Texas' natural waters based on historical data and the extent to which they attain the Texas Surface Water Quality Standards. The Texas Integrated Report satisfies the requirements of the federal Clean Water Act Sections 305(b) and 303(d). The 303(d) List must be approved by the EPA before it is final. An advisory group works with the TCEQ on biennial reviews of the *Guidance for Assessing Texas Surface Water Quality.* This guidance is included with each Integrated Report. The "Upper Basin" of the Colorado River has been defined as the classified mainstream segments 1411–1413 and 1426 and classified tributary segments 1421–1425. These segments fall within the SB 1 Regions F and G. The "Middle Basin" contains mainstream segments 1403–1410, 1429, and 1433 and tributary segments 1414–1417, 1427, 1431, and 1432. These segments fall within SB 1 Region F and Region K. The Colorado River's "Lower Basin" lies wholly within Region K and includes the mainstream segments 1401, 1402, 1428, and 1434 as well as several unclassified tributary segments and all of the Lake segments. *Table 1.7* lists these various segments and identifies the water quality criteria associated with them.

[19] TWDB, Op. Cit., May 1977.

Table 1.7: Classified Stream Segment Uses and Water Quality Criteria in the Colorado River Basin 2018

COLORADO RIVER BASIN			USES *			STATE STREAM STANDARDS CRITERIA **						
Stream Segment	Stream Segment Name	SB 1 Planning Region	Recreation	Aquatic Life	Water Supply	Chloride Annual Avg. (mg/L)	Sulfate Annual Avg (mg/L)	TDS Annual Avg (mg/L)	D.O. (mg/L)	pH Range	Fecal Coliform[1] (30-day geometric mean, CFU/100ml)	Temp (*F)
1401	Colorado River Tidal	K	PCR1	H					4.0	6.5–9.0	35	95
1402	Colorado River Below La Grange	K	PCR1	H	PS	100	100	500	5.0	6.5–9.0	126	95
1403	Lake Austin	K	PCR1	H	PS	100	75	400	5.0	6.5–9.0	126	90
1404	Lake Travis	K	PCR1	E	PS	100	75	400	6.0	6.5–9.0	126	90
1405	Marble Falls Lake	K	PCR1	H	PS	125	75	500	5.0	6.5–9.0	126	94
1406	Lake Lyndon B. Johnson	K	PCR1	H	PS	125	75	500	5.0	6.5–9.0	126	94
1407	Inks Lake	K	PCR1	H	PS	150	100	600	5.0	6.5–9.0	126	90
1408	Lake Buchanan	K	PCR1	H	PS	150	100	600	5.0	6.5–9.0	126	90
1409	Colorado River Above Lake Buchanan	K	PCR1	H	PS	200	200	900	5.0	6.5–9.0	126	91
1410	Colorado River Below O.H. Ivie Reservoir	K	PCR1	H	PS	500	455	1,475	5.0	6.5–9.0	126	91
1411	E. V. Spence Reservoir	F	PCR1	H	PS	440	360	1,630	5.0	6.5–9.0	126	93
1412	Colorado River Below Lake J. B. Thomas	F	PCR1	H		4,740	1,570	9,210	5.0	6.5–9.0	33	93
1413	Lake J. B. Thomas	F	PCR1	H	PS	140	250	520	5.0	6.5–9.0	126	90
1414	Pedernales River	K	PCR1	H	PS	125	75	525	5.0	6.5–9.0	126	91
1415	Llano River[2]	K	PCR1	H	PS	50	50	350	5.0	6.5–9.0	126	91
1416	San Saba River	K/G	PCR1	H	PS	50	50	425	5.0	6.5–9.0	126	90
1417	Lower Pecan Bayou	K	PCR1	H		310	120	1,025	5.0	6.5–9.0	126	90
1418	Lake Brownwood	F	PCR1	H	PS	150	100	500	5.0	6.5–9.0	126	90
1419	Lake Coleman	F	PCR1	H	PS	150	100	500	5.0	6.5–9.0	126	93
1420	Pecan Bayou Above Lake Brownwood	F	PCR1	H	PS	500	500	1,500	5.0	6.5–9.0	126	90
1421	Concho River	F	PCR1	H	PS	610	420	1,730	5.0	6.5–9.0	126	90
1422	Lake Nasworthy	F	PCR1	H	PS	450	400	1,500	5.0	6.5–9.0	126	93
1423	Twin Buttes Reservoir	F	PCR1	H	PS	200	100	700	5.0	6.5–9.0	126	90

Source: TCEQ (formerly TNRCC), 2018. URL: https://www.tceq.texas.gov/assets/public/waterquality/standards/tswqs2018/2018swqs_allsections_nopreamble.pdf (pg 81-82)

* Uses: PCR1 =Primary Contact Recreation 1; H = High Aquatic Life; E = Exceptional Aquatic Life; PS = Public Water Supply; AP = Aquifer Protection

** Criteria: Standards set by the TCEQ (formerly TNRCC) do not guarantee the water to be usable for municipal, domestic, irrigation, livestock, &/or industrial uses, such as segment #1412 & others; this causes the above screening process to be misleading for certain segments, especially for salinity.

[1] The indicator bacteria for freshwater is *E. coli* and for saltwater is Enterococci. The indicator bacteria for Segment 1412 is Enterococci.
[2] The critical low-flow for the South Llano River portion of Segment 1415 is calculated according to §307.8(a)(2)(B) of the Texas Administrative Code, Title 30.
[3] The critical low-flow for the South Concho River portion of Segment 1424 is calculated according to §307.8(a)(2)(B) of the Texas Administrative Code, Title 30.

Table 1.7 (Continued): Classified Stream Segment Uses and Water Quality Criteria in the Colorado River Basin 2018

COLORADO RIVER BASIN			USES *			STATE STREAM STANDARDS CRITERIA **						
Stream Segment	Stream Segment Name	SB 1 Planning Region	Recreation	Aquatic Life	Water Supply	Chloride Annual Avg. (mg/L)	Sulfate Annual Avg (mg/L)	TDS Annual Avg (mg/L)	D.O. (mg/L)	pH Range	Fecal Coliform[1] (30-day geometric mean, CFU/100ml)	Temp (*F)
1424	Middle Concho/South Concho River[3]	F	PCR1	H	PS	150	150	700	5.0	6.5–9.0	126	90
1425	O. C. Fisher Lake	F	PCR1	H	PS	150	150	700	5.0	6.5–9.0	126	90
1426	Colorado River Below E. V. Spence Reservoir	F	PCR1	H	PS	1000	1,100	1,770	5.0	6.5–9.0	126	91
1427	Onion Creek	K	PCR1	H	PS/AP[4]	100[5]	100[5]	500[5]	5.0	6.5–9.0	126	90
1428	Colorado River Below Lady Bird Lake/Town Lake[7]	K	PCR1	E	PS	100	100	500	6.0[6]	6.5–9.0	126	95
1429	Lady Bird Lake/Town Lake[7]	K	PCR1	H	PS	75	75	400	5.0	6.5–9.0	126	90
1430	Barton Creek[8]	K	PCR1	H	AP[4]	50	50	500	5.0	6.5–9.0	126	90
1431	Mid Pecan Bayou	F	PCR1			410	120	1,100	2.0	6.5–9.0	126	90
1432	Upper Pecan Bayou	F	PCR1	H	PS	200	150	800	5.0	6.5–9.0	126	90
1433	O. H. Ivie Reservoir	F	PCR1	H	PS	430	330	1,520	5.0	6.5–9.0	126	93
1434	Colorado River above La Grange	K	PCR1	E	PS	100	100	500	6.0	6.5–9.0	126	95

Source: TCEQ (formerly TNRCC), 2018. URL: URL: https://www.tceq.texas.gov/assets/public/waterquality/standards/tswqs2018/2018swqs_allsections_nopreamble.pdf (pg 81-82)

* Uses: PCR1 =Primary Contact Recreation 1; H = High Aquatic Life; E = Exceptional Aquatic Life; PS = Public Water Supply; AP = Aquifer Protection

** Criteria: Standards set by the TCEQ (formerly TNRCC) do not guarantee the water to be usable for municipal, domestic, irrigation, livestock, &/or industrial uses, such as segment #1412 & others; this causes the above screening process to be misleading for certain segments, especially for salinity.

[4] The aquifer protection use applies to the contributing, recharge, and transition zones of the Edwards Aquifer.

[5] The aquifer protection reach of Segment 1427 is assigned the following criteria: 50 mg/L for Cl^{-1}, 50 mg/L for $SO4^{-2}$, and 400 mg/L for TDS.

[6] Dissolved oxygen criterion of 6.0 mg/L only applies at stream flows greater than or equal to 150 cfs as measured at USGS Gauging Station 08158000 located in Travis County upstream from U.S. Highway 183. A dissolved oxygen criteria of 5.0 mg/L will applies to stream flows less than 150 cfs and greater than or equal to the 7Q2 for the segment.

[7] While Segment 1429 exhibits quality characteristics that would make it suitable for primary recreation, the use is prohibited by local regulation for reasons unrelated to water quality.

[8] The critical low-flow for Segment 1430 is calculated according to §307.8(a)(2)(A) of the Texas Administrative Code, Title 30.

Upstream of Region K, high salinity concentrations are the primary concern in the "Upper Basin" stream segments. This is caused both by the natural characteristics of the geologic formations in the watershed as well as pollution from oil and gas activities. As *Table 1.7* shows, some of these stream segments have very high water quality criteria for salinity, or total dissolved solids (TDS), which is an aggregate measurement of various mineral concentrations including chlorides, carbonates, and sulfates. The designated uses of a stream segment, such as recreation, aquatic life, and water supply, are based on the Texas Surface Water Quality Standards, which are criteria with the force of law. Potential uses for water in segments with very high salinity criteria, such as segment 1412 below Lake J. B. Thomas, are limited by the high TDS concentrations that exist, despite the fact that the criteria are rarely exceeded. For example, the secondary drinking water standard for TDS is 1,000 milligrams per liter (mg/l).

The water quality of the "Middle Basin" and "Lower Basin" improves significantly due largely to the dilution of the upstream base flow by inflow of higher quality tributary waters. Major tributaries from the headwaters of O. H. Ivie Reservoir down through the Highland Lakes System, namely the Llano River and the San Saba River, have TDS concentrations that are generally less than 500 mg/l at their confluence with the Colorado River. Water quality of the "Lower Basin" is subject to poor quality at low flow conditions due to salt water intrusion (i.e., tidal influence).

1.2.4 Agricultural and Natural Resources Issues Within the Lower Colorado Region [20, 21, 22, 23, 24]

The primary agricultural issue in the Lower Colorado Regional Water Planning Area is the availability of sufficient quantities of irrigation water for agricultural irrigation under dry year conditions. Natural resources, on the other hand, have impacts from both water quantity and water quality issues. Classified stream segments in the Colorado River Basin are shown in *Figure 1.23* and those with water quality concerns are listed below. The stream segments that have water quality concerns within the region are discussed below in *Section 1.2.4.1*. *Section 1.2.4.2* discusses threats due to water quantity issues.

1.2.4.1 Threats Within the Lower Colorado Region Due to Water Quality Issues

The primary water quality issue for all of the surface water stream segments and the major groundwater aquifers in the Lower Colorado Region is the increasing potential for water contamination due to nonpoint source pollution. Nonpoint source pollution is precipitation runoff that, as it flows over the land, picks up various pollutants that adhere to plants, soils, and man-made objects and which eventually infiltrates into the groundwater table or flows into a surface water stream. As additional land in the Colorado River watershed and aquifer recharge zones is developed, the runoff from precipitation events will pick up increasing amounts of pollution. Another nonpoint source of pollution is the accidental spill of toxic chemicals near streams or over recharge zones that will send a concentrated pulse of contaminated water through stream segments and/or aquifers. Public water supply groundwater wells that currently use only chlorination for water treatment, and domestic groundwater wells that may not treat the water before consumption, may be especially vulnerable to nonpoint source pollution, depending on how directly influenced they are by surface or near surface contamination. Habitats of threatened and endangered species that live in and near springs and certain stream segments may be vulnerable as well. Nonpoint sources of

[20] TCEQ (formerly TNRCC), Op. Cit., December 1996.
[21] TCEQ (formerly TNRCC), Op. Cit., October 1996.
[22] LCRA, March 1999, *Water Management Plan*.
[23] Texas Water Development Board (TWDB), February 2000. *A Numerical Groundwater Flow Model of the Upper and Middle Trinity aquifer, Hill Country Area*, Open-file report 00–02.
[24] TWDB, et al., April 1999. *Assessment of Groundwater Availability in the Carrizo-Wilcox aquifer in Central Texas – Results of Numerical Simulations of Six Groundwater-Withdrawal Projections (2000–2050)*, Draft Final Contract Report.

pollution are difficult to control and there has been increased awareness and research of this issue as well as interest in the initiation of abatement programs. The water management strategies recommended in this plan won't necessarily impact the water quality levels in the region, but as population growth and development occurs, more opportunities for nonpoint source pollution may exist.

The TCEQ categorizes the physical use of a stream into various defined uses such as "general use," "aquatic life use," "recreational contact use," and "public water supply use." Assessments of the basin conducted by TCEQ determine whether or not a stream segment will support its use. Segments which do not support its designated or assumed use are classified as impaired. Additionally, these assessments will identify segments which are of concern for not meeting the use but are not at the time of the assessment considered impaired. There are 20 stream segments in Region K considered impaired as published in the Draft 2016 303(d) List. Additionally, 35 stream segments are listed as "of concern" for exceeding the State Water Quality Criteria in Region K (*Table 1.8 and Table 1.9*).

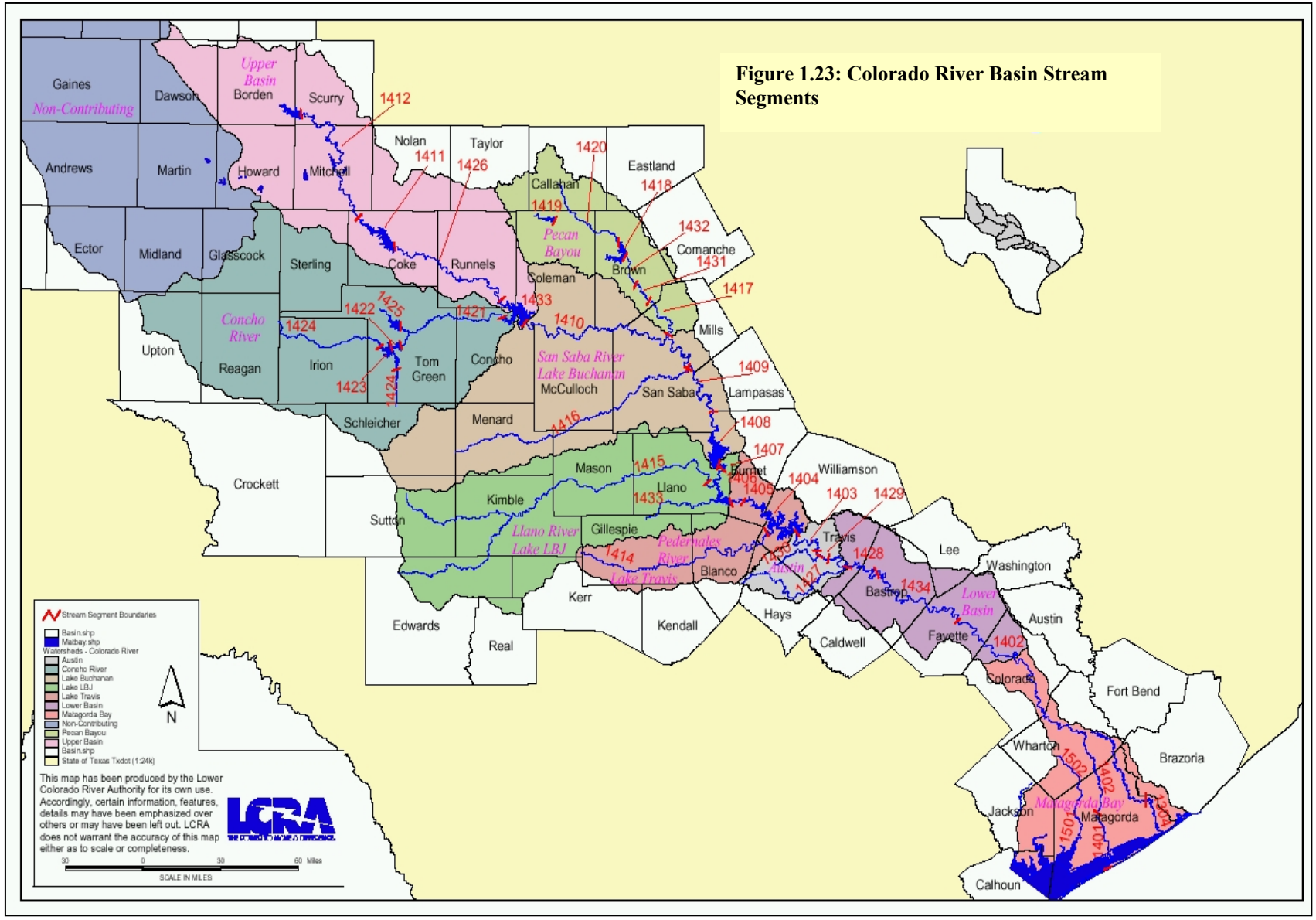


Figure 1.23: Colorado River Basin Stream Segments

Table 1.8: Stream Segment Water Quality Impairments in the Lower Colorado Region[1,2]

Segment ID #	Segment Name	Stream Use	Impairment
1217D	North Fork Rocky Creek (unclassified water body)	Aquatic Life	Depressed dissolved oxygen
1301	San Bernard River Tidal	Recreation Use	Bacteria
1302	San Bernard River Above Tidal	Recreation Use	Bacteria
1302A	Gum Tree Branch (unclassified water body)	Recreation Use	Bacteria
1302B	West Bernard Creek (unclassified water body)	Aquatic Life and Recreation Use	Depressed dissolved oxygen and Bacteria
1302D	Peach Creek	Recreation Use	Bacteria
1304	Caney Creek Tidal	Recreation Use	Bacteria
1304A	Linnville Bayou (unclassified water body)	Recreation Use	Bacteria
1305	Caney Creek Above Tidal	Aquatic Life	Depressed dissolved oxygen
1402	Colorado River below La Grange	Recreation Use	Bacteria
1402C	Buckners Creek	Aquatic Life	Depressed dissolved oxygen
1402H	Skull Creek (unclassified water body)	Aquatic Life Use	Depressed dissolved oxygen
1403A	Bull Creek (unclassified water body)	Aquatic Life Use	Depressed dissolved oxygen
1407A	Clear Creek (unclassified water body)	General Use	Aluminum, nickel, and zinc in water; pH; Sulfate; and Total Dissolved Solids
1416	San Saba River	Recreation Use	Bacteria
1416A	Brady Creek (unclassified water body)	Aquatic Life Use	Depressed dissolved oxygen
1427A	Slaughter Creek (unclassified water body)	General Use	Impaired Macrobenthic Community
1429C	Waller Creek (unclassified water body)	Recreation Use and General Use	Bacteria and Impaired Macrobenthic Community
1501	Tres Palacios Creek Tidal	Aquatic Life	Depressed dissolved oxygen
2441OW	East Matagorda Bay (Oyster Waters)	Recreation Use	Bacteria (oyster waters)

[1] Texas Commission on Environmental Quality (URL: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_303d.pdf) (Draft 2016 Texas 303 (d) List).
[2] Texas Commission on Environmental Quality (URL: http://www.tceq.texas.gov/gis/segments-viewer)

Table 1.9: Stream Segment Water Quality Concerns in the Lower Colorado Region[1]

Segment ID #	Segment Name	Stream Use	Concern
1401	Colorado River Tidal	General Use	Nitrate
1402	Colorado River below La Grange	General Use	Nitrate and chlorophyll-a
1402A	Cummins Creek (unclassified water body)	Aquatic Life Use	Depressed dissolved oxygen, impaired habitat, and impaired fish community
1402C	Buckners Creek (unclassified water body)	General Use	chlorophyll-a
1402H	Skull Creek (unclassified water body)	General Use	chlorophyll-a
1403	Lake Austin	General Use	Manganese in sediment
1403A	Bull Creek (unclassified water body)	Recreation Use	Bacteria
1403B	West Bull Creek (unclassified water body)	Recreation Use	Bacteria
1403D	Barrow Preserve Tributary (unclassified water body)	General Use	Nitrate
1403E	Stillhouse Hollow (unclassified water body)	General Use	Nitrate
1403J	Spicewood Tributary to Shoal Creek (unclassified water body)	General Use	Nitrate
1404	Lake Travis	Aquatic Life Use	Depressed dissolved oxygen
1404A	Hamilton Creek (unclassified water body)	General Use	chlorophyll-a
1407	Inks Lake	General Use	Manganese in sediment
1407A	Clear Creek (unclassified water body)	General Use	Cadmium in water
1409	Colorado River Above Lake Buchanan	General Use	chlorophyll-a
1410	Colorado River Below O. H. Ivie Reservoir	General Use	chlorophyll-a
1416A	Brady Creek (unclassified water body)	General Use	Nitrate, total phosphorus, and chlorophyll-a
1416C	Brady Creek above Brady Creek Reservoir (unclassified water body)	General Use	Nitrate
1417	Lower Pecan Bayou	General Use	Chlorophyll-a
1427A	Slaughter Creek (unclassified water body)	Aquatic Life Use	Depressed dissolved oxygen
1427G	Granada Hills Tributary to Slaughter Creek (unclassified water body)	General Use	Nitrate
1428	Colorado River Below Lady Bird Lake (formerly Town Lake)	Aquatic Life and General Use	Impaired fish and microbenthic community, nitrate, and total phosphorus
1428B	Walnut Creek (unclassified water body)	Recreation and Aquatic Life Use	Bacteria, impaired macrobenthic community, and impaired habitat
1428C	Gilleland Creek (unclassified water body)	General Use	Nitrate
1429	Lady Bird Lake (formerly Town Lake)	General Use	dibenz(a,h)anthracene in sediment

Segment ID #	Segment Name	Stream Use	Concern
1429C	Waller Creek (unclassified water body)	General Use	Benz(a)antracene in sediment, benzo(a)pyrene in sediment, chrysene in sediment, dibenz(a,h)anthracene in sediment, fluoranthene in sediment, lead in sediment, phenanthrene in sediment, and pyrene in sediment
1429D	East Bouldin Creek (unclassified water body)	General Use	benz(a)antracene in sediment, cadmium in sediment, chrysene in sediment, dibenz(a,h)anthracene in sediment, fluoranthene in sediment, lead in sediment, phenanthrene in sediment, and pyrene in sediment
1430	Barton Creek	Aquatic Life Use	Depressed dissolved oxygen and toxicity in sediment
1430A	Barton Springs (unclassified water body)	Aquatic Life Use	Depressed dissolved oxygen and toxicity in sediment
1434	Colorado River above La Grange	General Use	Total phosphorous and nitrate
1434B	Cedar Creek (unclassified water body)	Aquatic Life Use	Depressed dissolved oxygen
1434D	Wilbarger Creek (unclassified water body)	General Use	Chlorophyll-a and nitrate
1434E	Big Sandy Creek (unclassified water body)	General and Aquatic Life Use	Chlorophyll-a and depressed dissolved oxygen
1434G	Alum Creek (unclassified water body)	Aquatic Life, General, and Recreation Use	Depressed dissolved oxygen, ammonia, and bacteria

[1] Texas Commission on Environmental Quality
(URL: https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_concerns.pdf)

A major surface water quality indicator for protection of aquatic life is dissolved oxygen (DO) and the associated biochemical oxygen demand (BOD). DO is a measure of the amount of oxygen that is available in the water for metabolism by microbes, fish, and other aquatic organisms. BOD is a measure of the amount of organic material, containing carbon and/or nitrogen, in a body of water that is available as a food source to microbial and other aquatic organisms, which require the consumption of dissolved oxygen from the water to metabolize the organic material. The basin-wide concentrations of DO that have existed in the past were indicative of relatively unpolluted waters; however, these have been changing and have become a concern in some segments of the Colorado River and its tributaries, as populations and urban development continue to increase. The primary manmade sources of BOD in bodies of water are the discharge of municipal and industrial waste, as well as nonpoint source pollution from urban and agricultural runoff. Thus, the presence of excess amounts of BOD allows increased rates of microbial and algal metabolism, which in turn depletes the dissolved oxygen concentrations in the water. Without sufficient levels of DO in

the water, other aquatic organisms such as fish cannot survive. Data from 2016 indicates that there are eight classified stream segments with a DO impairment (*Table 1.8*) and eight with a concern for DO (*Table 1.9*), based on the State Water Quality Criteria in the Lower Colorado Regional Water Planning Area.

Another set of surface water quality indicators that can deplete DO levels in surface water bodies are termed "nutrients" and includes nitrogen (Kjeldahl nitrogen, nitrite+nitrate, and ammonia nitrogen), phosphorus (phosphates, orthophosphates, and total phosphorus), sulfur, potassium, calcium, magnesium, iron, and sodium. Nutrients are monitored by the TCEQ as a part of the Texas Clean Rivers Program; however, there are no state or federal standards for screening nutrients. However, the TCEQ is conducting studies to develop potential numerical nutrient criteria for select bodies of water in Texas. Currently, naturally occurring background levels reported by the U.S. Geological Survey (USGS) or historical data collected by the TCEQ are used to determine the level of concern for nutrients. Nutrients have the same primary man-made sources as the BOD sources described above. Based on 2016 data, there are 13 classified stream segments with a concern *(Table 1.9)* in the Lower Colorado Regional Water Planning Area.

Fecal indicator organisms E. coli and Enterococcus are generally harmless bacteria that are present in human and/or animal waste, although some E. coli can be pathogenic. However, the presence of these organisms is an indicator for the presence of disease-causing bacteria, protozoa and viruses that are also found in human/animal wastes. Municipal waste is treated to remove most of the bacterial, protozoan and viral contaminants so that safe levels will exist in the surface water body upon discharge from the point source. Therefore, when fecal indicators are detected, the most likely source of contamination should be nonpoint source pollution, which can include agricultural runoff as well as runoff from failed septic systems. A wastewater treatment plant point source could also be the source of contamination if the system is not functioning properly. Data reported for 2016 indicate that there are a number of classified stream segments with impairments for E. coli and the tidal portion is impaired for the presence of Enterococcus, based on the State Water Quality Criteria in Region K (*Table 1.8*).

The presence of toxic dissolved metals, such as aluminum, barium, arsenic, chromium, cadmium, copper, lead, nickel, manganese, mercury, selenium, silver, and zinc, in surface water are a concern in five classified stream segments in the Lower Colorado Regional Water Planning Area (*Table 1.9*).

1.2.4.2 Threats Due to Water Quantity Issues

Threats are present in Region K from both too much water and from too little water. Too much water can be an issue during high river flows and during flooding episodes. The Highland Lakes provide the primary surface water storage and flood control capabilities for Region K.

In addition to managing the Highland Lakes for water supply, LCRA also operates the lakes for flood control purposes. When flooding on the lakes or their tributaries is imminent, LCRA works to manage the floodwaters by holding or moving water as needed through a series of dams along the Highland Lakes. Flood Operations take precedence over scheduled water supply and environmental release operations. Of the six Highland Lakes, only Lake Travis – formed by Mansfield Dam – is designed to hold back floodwaters that otherwise would flood Austin and downstream communities. Lake Travis has a large flood pool that can temporarily store some floodwaters flowing into the lakes upstream of Mansfield Dam.

As mentioned previously, the primary threat to agriculture in Region K is water shortages for irrigation that are anticipated to occur in Matagorda, Wharton, and Colorado counties during drought. The water supply available for irrigation is from three sources: ROR supplies, stored water from the Highland Lakes and the

anticipated Arbuckle Reservoir, and groundwater. When the Colorado River's natural flows are insufficient to meet irrigation demands, allocations of stored water from the Highland Lakes under the LCRA Water Management Plan can be made by to supplement the available downstream ROR supplies. The water supplied from the Highland Lakes storage is an interruptible supply and is subject to curtailment in accordance with policies and procedures specified in LCRA's Water Management Plan. Under drought conditions, there are substantial shortages of water for irrigation in Matagorda, Wharton, and Colorado Counties. The shortages will be addressed through water management strategies such as conservation, discussed in *Chapter 5* of this Plan. Details related to drought responses associated with the LCRA Water Management Plan are discussed in *Chapter 7* of this Plan.

Water quantity is also a concern during drought conditions in terms of instream flows and freshwater inflows to Matagorda Bay. As discussed in *Section 1.2.2.3*, the reaches below the Highland Lakes downstream to the mouth of the Colorado River have been studied by the LCRA, and "Subsistence" instream flows have been determined as firm demands on water resources. Instream flows have been maintained by LCRA at or above the minimum "Subsistence" flow in accordance with the 2015 WMP. "Base" (Base-Dry and Base-Average) instream flows, also determined by the LCRA study, provide flows to support an optimal range of habitat complexity for a well-balanced, native aquatic community within a stream reach. LCRA has maintained these flow regimes whenever water resources are adequate, but "Base" flows are classified as interruptible demands that have been reduced during drought conditions. For further details, please refer to LCRA's WMP at https://www.lcra.org/water/water-supply-planning/water-management-plan-for-lower-colorado-river-basin/Documents/FINAL-WMP-AsApprovedbyTCEQ-Nov-2015.pdf.

The Highland Lakes provide the primary surface water storage and flood control capabilities for Region K. The issue of providing maintenance of these reservoirs to retain the maximum water storage capacity may become important as natural sedimentation processes decrease the volume of water each reservoir can hold.

As mentioned above, Lake Travis is the only reservoir in the Highland Lakes with flood control storage. LCRA conducts flood operations at Mansfield Dam according to the U.S. Army Corps of Engineers (USACE) Water Control Manual for Mansfield Dam and Lake Travis. The Water Control Manual limits flood releases from Mansfield Dam based on key Lake Travis elevations and expected conditions along the Colorado River downstream of Mansfield Dam. Under the USACE requirements, Flood Operations at Mansfield Dam are determined by: specified ranges of observed or forecasted lake levels; the pool condition (i.e. rising or falling); the month of the year; and stage and flow criteria at three designated downstream locations. When the pool is rising, forecasted lake levels (based on actual water on the ground) are used in determining flood release requirements. When the pool is falling, observed lake levels are used in determining release requirements. The amount of release from Mansfield Dam increases with higher ranges of lake level and as long as downstream stage and flow limitations are not exceeded.

One of the major groundwater quantity concerns involves the Barton Springs segments of the Edwards aquifer (BFZ), which is a karst formation that responds quickly to changes in the environment due to its highly permeable and transmissive characteristics. South of the artesian zone of the Edwards aquifer there exists an interface, or "bad water line," that separates the good quality groundwater from a layer of water that is not usable for human consumption, without further treatment, due to the high TDS content. This line, which is also referred to as the saline-water line or freshwater/saline-water interface, marks the interface where the groundwater reaches a TDS concentration of 1,000 mg/l. Research is currently being conducted to determine the effects that pumping large quantities of aquifer water will have on its location. Water

management strategies recommended in *Chapter 5* discuss Aquifer Storage and Recovery (ASR) opportunities in this aquifer, as well as desalination of water produced from the saline zone.

A second major issue in the Barton Springs segments of the Edwards aquifer (BFZ) is the amount of discharge from the artesian zone through Barton Springs. Increased groundwater pumping from the aquifer during drought conditions decreases all spring discharges, which can potentially impact the state- and federally-listed threatened and endangered species that depend on the springs for habitat, such as the Barton Springs salamander, and can potentially affect water supply availability downstream. Because the Barton Springs Edwards Aquifer Conservation District has considered maintenance of certain minimum springflows in setting its Desired Future Condition, so long as recommended water management strategies stay within the Modeled Available Groundwater (MAG) volume, impacts to the minimum springflows are expected to be negligible.

The primary water quantity issue in the Gulf Coast aquifer is subsidence, which is the dewatering of the interlayers of clay within the aquifer as a result of continued or long-term over-pumping. The resultant compaction of the clay causes a loss of water storage capacity in the aquifer, which in turn causes the land surface to sink, or subside. Once the ability of the clay to store water is gone, it can never be restored. The implementation of water conservation practices and conversion to other sources are currently the only remedies for this situation. Saltwater intrusion from the Gulf of Mexico into the Gulf Coast aquifer is also a potential concern due to groundwater pumping rates that are greater than the recharge rates of the aquifer. Recommended water management strategies in this Plan stay within the Modeled Available Groundwater (MAG) volume, and overpumping is not encouraged.

The primary water quantity concern with the Trinity aquifer is the anticipated water-level decline during drought conditions due to increased demand that will be placed on the aquifer's resources. Studies indicate that water levels in the portion of the aquifer that lies within Region K in the Dripping Springs area of Hays County could decline more than 100 feet by the year 2040. Other portions of Hays County as well as Blanco and Travis Counties, may experience moderate water-level declines between 50 to 100 feet by the year 2020. Most of the streams gain water as they pass over the Trinity aquifer and in consequence may be affected by the declining water levels in the underlying aquifer. In addition, drought conditions may further decrease the base flow of the streams. Recommended water management strategies in this Plan stay within the Modeled Available Groundwater (MAG) volume for the Trinity Aquifer in Region K.

The primary water quantity concern with the Carrizo-Wilcox aquifer is the water-level decline that could occur by the year 2070 due to increased pumping. The Carrizo-Wilcox Aquifer is in Bastrop and Fayette counties, within Region K. The area in and around the Carrizo-Wilcox aquifer is expected to see continued population growth and increases in water demand. Current usage could cause water level decline of up to 240 feet in Bastrop County, depending on the formation, and up to 110 feet of decline in Fayette County. Projected demands show that additional groundwater will be needed and some water users in Bastrop County may need to look at surface water as an option in the future. The relationships that currently exist between surface and groundwater may also change. Some model simulations indicate that the Colorado River, which currently gains water from the Carrizo-Wilcox aquifer within certain portions of Bastrop County, may begin to lose water to the aquifer by the year 2050. Recommended water management strategies in this Plan stay within the Modeled Available Groundwater (MAG) volume.

The LCRWPG passed a resolution regarding the "mining of groundwater" on February 9, 2000, which strongly opposes the over-utilization of groundwater, including the mining of groundwater, within its region at rates that could lead to eventual harm to the groundwater resources, except during limited periods of

extreme drought. The LCRWPG defines groundwater mining as "the withdrawal of groundwater from an aquifer at an annualized rate, which exceeds the average annualized recharge rate to an aquifer where the recharge rate can be scientifically derived with reasonable accuracy." This resolution addresses the concerns listed above for the Barton Springs segments of the Edwards (BFZ), Gulf Coast, Trinity, and Carrizo-Wilcox aquifers that are located within Region K.

1.2.5 Existing Water Planning in the Lower Colorado Regional Water Planning Area

As charged by Senate Bill 1 (SB 1), enacted in 1997, the LCRWPG prepared, adopted, and submitted the *2000 Region "K" Water Supply Plan* to the TWDB, which described how local entities may address future water supply needs for the next 50 years. Subsequently, a State Water Plan, Water for Texas-2002, was delivered by the TWDB to the Texas Legislature in January 2002, and incorporated the approved 2001 Regional Water Plan and contained legislative recommendations for future water policies. This cycle of planning is repeated every five years and thus far has resulted in the 2006, 2011, and 2016 *Region K Water Plans* being submitted to the TWDB by the Lower Colorado Regional Water Planning Group. These regional plan updates assisted in the creation of the 2007, 2012, and 2017 State Water Plans by the TWDB. The current cycle of regional water planning will culminate in the 2021 Lower Colorado Regional Water Plan, which the TWDB will utilize in developing the 2022 State Water Plan.

Because regional water planning is intended to be a bottom-up process, the Region K planning group used knowledge from its own members as well as publicly available local plans to develop the details of the 2021 Region K Water Plan. Documents from local planning efforts, including the City of Austin *Water Forward Plan*[25], *Regional Water Supply Study for the City of Wharton and East Bernard*[26], *Water and Wastewater Facilities Plan for the portion of Hays County, Texas West of the I-35 Corridor*[27], the *Bastrop Regional Water Supply Facilities Planning Study*[28], and the *Burnet-Llano County Regional Water Facility Study*[29], helped shape the water management strategies that were recommended by the Region K planning group. These local plans also provided a few potential regionalization concepts for water and wastewater services that the Region K planning group considered during the planning process. The LCRA 2015 Water Management Plan is also referenced for several chapters in the 2021 Region K Plan, although an updated version (LCRA 2020 WMP) was approved by TCEQ in February 2020. Additional publicly available local plans that were referenced for the planning process are discussed below in the next few sections.

SB 1 legislation also amended Chapter 36 of the Texas Water Code to require certain water supply entities to develop water management plans (WMPs), water conservation plans (WCPs), and/or drought contingency plans (DCPs). WCPs and DCPs must be submitted to TCEQ for review and certification. TCEQ received the plans, reviewed them for minimum criteria according to TCEQ's Chapter 288 Rules that reflect SB 1 requirements. Finally, TCEQ sent the water supply entity a letter of certification that its plan contains the necessary minimum criteria components. It should be noted that TCEQ has not subjectively critiqued the quality of the water management, water conservation, or drought contingency plans; it only determined whether or not minimum criteria have been met. Each water supply entity is required to update their respective plan every five years, so that the plan will improve as the water supply entity gains experience in managing its water resources. TWDB also receives copies of each certified WCP

[25] *Water Forward Integrated Water Resource Plan*, Austin Water, November 2018.
[26] *Regional Water Supply Study for the City of Wharton and East Bernard,* TWDB Contracted Report, Halff, April 2017.
[27] *Water and Wastewater Facilities Plan for the portion of Hays County, Texas West of the I-35 Corridor*, TWDB Contracted Report, HDR Engineering, January 2011.
[28] *Bastrop Regional Water Supply Facilities Planning Study,* TWDB Contracted Report, K Friese & Associates, Inc., October 2011.
[29] *Burnet-Llano County Regional Water Facility Study,* TWDB Contracted Report, Susan Roth, CDM, December 2011.

and DCP for review with respect to TWDB's water planning efforts. However, there are no rules requiring action by TWDB.

1.2.5.1 Groundwater Conservation District Management Plans (MP)

One category of the SB 1 required plan is the Management Plan (MP), which must be developed by each Groundwater Conservation District (GCD) and surface water conservation district in the state. The intent of a MP is to conserve, preserve, prevent waste, protect, and recharge water supplies within the water conservation district. These MPs are required to be submitted to TWDB for review and administrative certification. Surface water conservation districts, primarily river authorities, are also required to submit MPs as a provision of the final adjudication of the river authority's water rights and receive administrative certification from TCEQ.

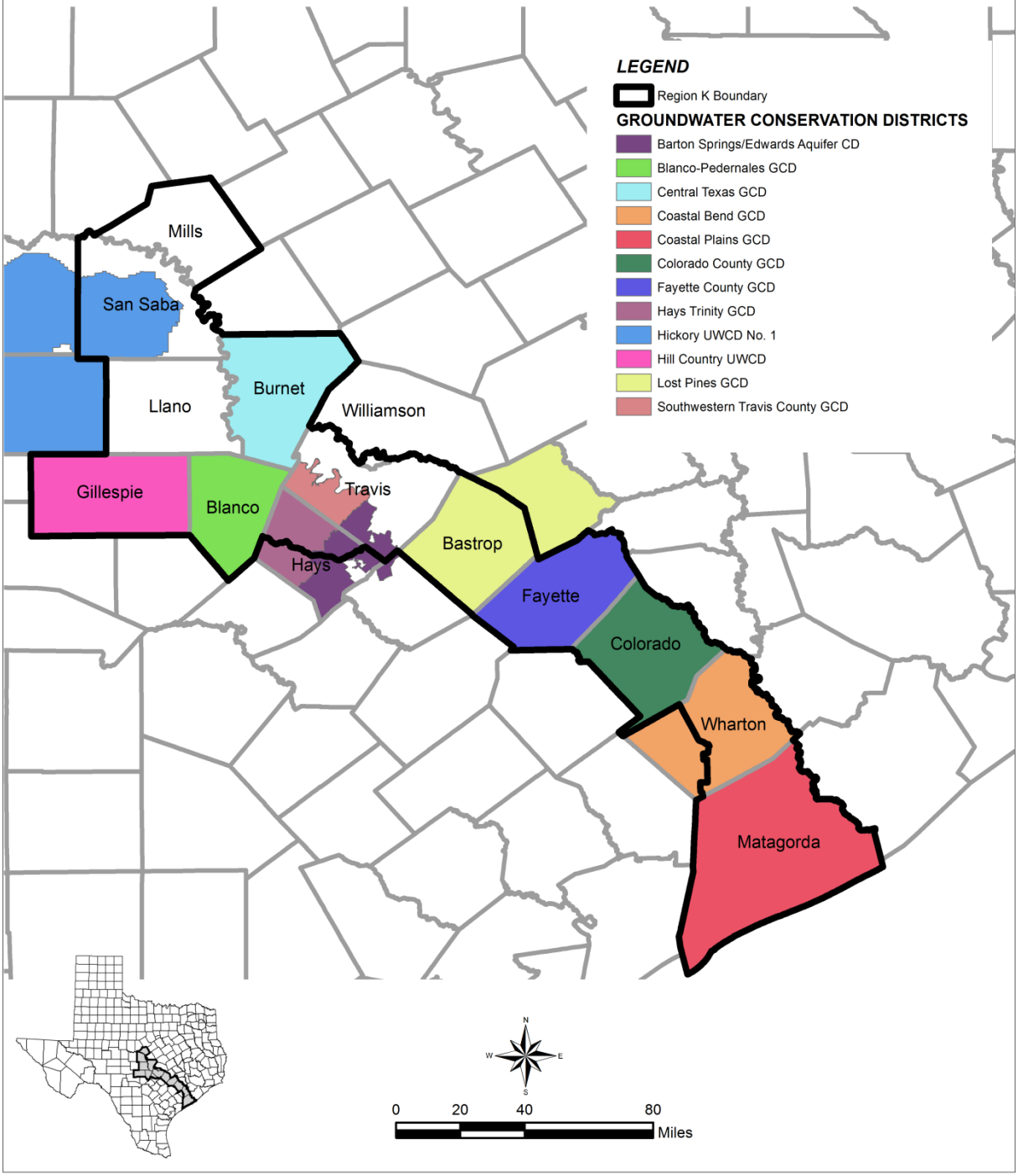
There are 12 confirmed GCDs in Region K. *Table 1.10* shows each district and the aquifers they manage. Through House Bill 4345, the 85th Legislature of Texas created Southwestern Travis County GCD. MPs are also submitted to RWPGs for inclusion in the Regional Water Plan and to allow the regional planning groups to focus on strategies for current and future shortages that do not conflict with the management plans. *Figure 1.24* shows the groundwater conservation districts located in Region K.

Table 1.10: Groundwater Conservation Districts in Lower Colorado Region

Groundwater Conservation District [1]	Lower Colorado Region County	Aquifers Managed [2]
Barton Springs/Edwards Aquifer Conservation District (BSEACD)	Hays, Travis	Edwards (BFZ) & Trinity Aquifers, & Alluvial Deposits
Blanco-Pedernales GCD	Blanco	Trinity, Edwards-Trinity, Ellenburger, Hickory and Marble Falls Aquifers
Central Texas GCD	Burnet	Trinity, Marble Falls, Ellenburger-San Saba, Hickory
Coastal Bend GCD	Wharton	Gulf Coast Aquifer
Coastal Plains GCD	Matagorda	Gulf Coast Aquifer
Colorado County GCD	Colorado	Gulf Coast Aquifer
Fayette County GCD	Fayette	Gulf Coast, Carrizo-Wilcox, Queen City, Sparta Aquifer, Yegua- Jackson and Colorado River Alluvium
Hays-Trinity GCD	Hays	Trinity Aquifer
Hickory UWCD #1	San Saba	Hickory Aquifer, Ellenberger-San Saba, & Marble Falls Aquifers
Hill Country UWCD	Gillespie	Edwards-Trinity, Ellenberger-San Saba, & Hickory Aquifers
Lost Pines GCD	Bastrop	Carrizo-Wilcox Aquifer
Southwestern Travis County GCD [3]	Travis	Trinity Aquifer

Source: TWDB
[1] UWCD = Underground Water Conservation District; GCD = Groundwater Conservation District.
[2] Water systems managed: Only portions of the indicated aquifer systems are located within a GCD's jurisdiction.
[3] Groundwater Conservation District confirmed in November 2019.

Figure 1.24: Lower Colorado Regional Water Planning Area (Region K) Groundwater Conservation Districts



1.2.5.2 Groundwater Management Areas (GMA)

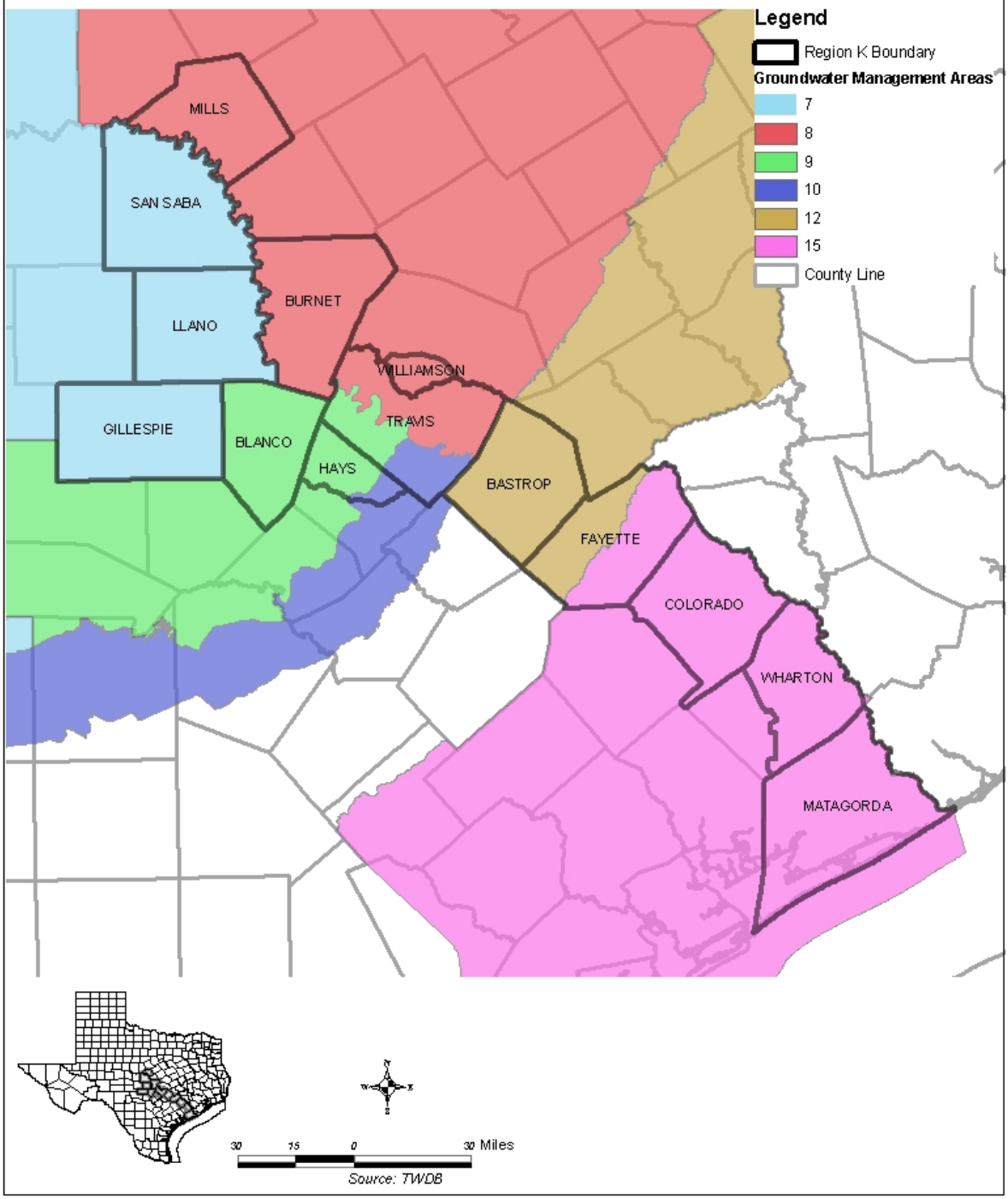
In response to legislation passed in 2001, in December 2002 the TWDB designated 16 GMAs covering the entire state. In 2005, the legislature required all GCDs located within a GMA to conduct joint planning. The new requirements indicated that,

"Not later than September 1, 2010, and every five years thereafter, the districts shall consider groundwater availability models and other data or information for the management area and shall establish desired future conditions for the relevant aquifers within the management area."

Groundwater districts are required to meet at least annually to decide on "desired future conditions" for the aquifers within their GMA. A desired future condition is a quantifiable future groundwater condition. These conditions, called metrics, can be a particular groundwater level, level of water quality, volume of spring flow, etc. Based on the adopted desired future condition, the TWDB is responsible for providing each groundwater conservation district and regional water planning group, located wholly or partly in the management area, with a modeled available groundwater volume (MAG) that will be used for planning and groundwater management purposes. Groundwater availability models and other data or information help in establishing modeled available groundwater for the relevant aquifers within the management area.

In Region K, there are six groundwater management areas (GMAs). They include GMA-7, GMA-8, GMA-9, GMA-10, GMA-12, and GMA-15. *Figure 1.24* shows the delineation of these groundwater management areas.

Figure 1.25: Lower Colorado Regional Water Planning Area (Region K) Groundwater Management Areas



1.2.5.3 Water Conservation Plans (WCP) and Drought Contingency Plans (DCP)

SB 1 also required each entity that possesses major surface water and/or groundwater rights to develop a Water Conservation Plan (WCP). While Region K supports the need for conservation by all water users, these particular plans are required by irrigation water rights of at least 10,000 ac-ft/yr, non-irrigation (municipal, industrial, mining, recreational) water rights of at least 1,000 ac-ft/yr, and retail public water suppliers which serve 3,300 connections or more. In addition, LCRA requires all of its water contract holders to have a WCP and LCRA staff reviews and approves individualized WCPs for all municipal customers with standard water contracts and for all irrigation customers with standard water contracts over 20 acre-feet. The intent of the WCP is to develop and implement programs that will reduce water use within each of the major WUGs, primarily through utilizing advances in technology, reducing distribution system water losses, increasing irrigation efficiency (sometimes required, sometimes voluntary), and educating customers and encouraging voluntary participation in water use efficiency efforts. Approximately 80 percent of Region K's water use occurs in the agricultural irrigation and municipal sectors, and the majority of the WCPs have targeted these two water use groups. The remainder of entities holding water rights in Region K are not required to develop or submit a WCP unless they petition TCEQ for an amendment to their water right or apply for a capital improvement loan with TWDB. In addition, Chapter 288 of the TCEQ Rules requires wholesale water supply purchasers to submit water conservation plans to their wholesale supplier. More details on Water Conservation Plans are provided in *Chapter 5* of this Plan.

The third category of water resource planning effort required by SB 1 is the Drought Contingency Plan (DCP). The intent of the DCP is to specify how a water supply entity will contract and supply dependable stored water supplies to its customers during a repeat of the drought of record, which is the period 2007–2016 for Region K. Triggering conditions for water shortages during a drought must be defined, and the actions that will be taken by the water supplier to mitigate the adverse effects of these water shortages must be specified. The DCP's major goals are extending the supplies of dependable water, preserving essential water uses, protecting public health and safety, and establishing equitable distributions of water among the water supplier's customers.

The most recently amended Title 30, Texas Administrative Code, Chapter 288 became effective on August 16, 2018. The next revision of the drought contingency plans for retail public water suppliers serving 3,300 or more connections, wholesale public water suppliers, and irrigation districts were to be submitted no later than May 1, 2019, and every five years thereafter to coincide with the regional water planning group process. Any new or revised plans must be submitted to the TCEQ within 90 days of adoption by the governing body of the entity. Drought contingency plans are to be provided to the local regional water planning group as well; however, the RWPGs do not review or certify drought contingency plans. LCRA has a detailed template DCP that many of its customers adopt entirely or with minor modifications. More details on Drought Contingency Plans are provided in *Chapter 7* of this Plan.

For all retail public water suppliers serving less than 3,300 connections, the drought contingency plans were to be prepared and available for inspection upon request, but they were not required to be submitted to TCEQ. LCRA requires all water contract holders to adopt a drought contingency plan.

The definition of a WUG for municipal purposes has been expanded to include entities that provide retail water service in excess of 100 ac-ft/yr, or approximately 89,000 gallons per day (gpd). Systems which serve 3,300 connections, assuming 3.2 persons per connection and 130 gallons per person per day, would be serving approximately 1.4 million gallons per day (mgd). As a result, the WUGs covered in the category of

less than 3,300 connections will have water usage ranging from 89,000 gpd to 1.3 mgd, or 100 to 1,540 ac-ft/yr. Entities with less than 100 ac-ft/yr of usage are included in the County-Other Municipal WUG.

1.2.5.4 Water Audits

House Bill 3338, passed by the 78th Texas Legislature (2003), requires retail public utilities providing potable water to file water audits with the TWDB once every five years giving the most recent year's water loss. TWDB subsequently commissioned a study of available loss data. The results of this statewide data gathering was compiled into the "Analysis of Water Loss as Reported by Public Water Suppliers in Texas," TWDB, 24 January 2007. Water loss audit information compiled by the TWDB is required to be included in the regional water plans and should be considered when evaluating conservation water management strategies. For this planning cycle, 2015-2017 water loss audit information was provided to the LCRWPG by TWDB. Water loss audit summary reports with data for individual reporting entities are available on TWDB's website approximately two years after the reporting year.

One hundred and twenty-seven (127) public utilities in Region K submitted water loss audit data as part of the required 2015 submittal to TWDB. Limited data was available for 2016 and 2017, so the 2015 data is used for this report. Total loss rates for the utilities within Region K were found to vary widely, with an average total water loss percentage rate of 16.0%. Losses may vary annually and could currently be higher or lower.

Total losses are not limited to loss from known leaks, although for some utilities leakage is responsible for a majority of lost water. Total loss also includes meter inaccuracy, unmetered or unauthorized water use, unidentified line leaks, and storage overflows. Real loss accounts for reported breaks and leaks, and unreported loss. Real loss rates for the utilities within Region K were also found to vary widely, with an average real loss percentage rate of 14.1%.

Figure 1.26 on the following page summarizes the water loss audit data provided by TWDB to Region K.

Figure 1.26: Water Loss Audit Summary for Region K for 2015

<table>
<tr><td rowspan="8">Region K
127 Audits Submitted</td><td rowspan="8">System Input Volume
60,139,440,957</td><td rowspan="4">Authorized Consumption
50,528,887,536
84.0%</td><td rowspan="2">Billed Consumption
49,783,342,164
82.8%</td><td>Billed Metered
49,774,131,680
82.8%</td><td rowspan="2">Revenue Water
49,783,342,164
82.8%</td></tr>
<tr><td>Billed Unmetered
9,210,484
0.0%</td></tr>
<tr><td rowspan="2">Unbilled Consumption
745545372
1.2%</td><td>Unbilled Metered
379,157,482
0.6%</td><td rowspan="6">Non-revenue Water
10,356,098,793
17.2%</td></tr>
<tr><td>Unbilled Unmetered
366,387,890
0.6%</td></tr>
<tr><td rowspan="4">Water Loss
9,613,031,136
16.0%</td><td rowspan="3">Apparent Loss
1,142,527,910
1.9%</td><td>Unauthorized Consumption
145,360,586
0.2%</td></tr>
<tr><td>Customer Meter Accuracy Loss
995,496,677
1.7%</td></tr>
<tr><td>Systematic Data Handling Discrepency
1,796,777
0.0%</td></tr>
<tr><td rowspan="2">Real Loss
8,470,543,773
14.1%</td><td>Reported Breaks and Leaks
347,086,603
0.6%
Unreported Loss
8,123,457,170
13.5%</td></tr>
</table>

Source: 2015 Summary of Water Loss Audit Data by Gallons and Percentage by Region with Statewide Totals

APPENDIX 1A

THREATENED AND ENDANGERED SPECIES IN THE LOWER COLORADO REGIONAL WATER PLANNING AREA (Texas Parks & Wildlife Department Special Species Lists and Annotated County Lists of Rare Species)

KEY: COUNTY THREATENED OR ENDANGERED SPECIES

LE, LT	Federally Listed Endangered/Threatened
PE, PT	Federally Proposed Endangered/Threatened
SAE, SAT	Federally Endangered/Threatened by Similarity of Appearance
C1	Federal Candidate for Listing, formerly Category 1 Candidate
DL, PDL	Federally Delisted/Proposed for Delisting
NL	Not Federally Listed
E, T	State Listed Endangered/Threatened
NT	Not tracked or no longer tracked by the State
"blank"	Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

Source: Texas Parks and Wildlife Department Special Species Lists and Annotated County Lists of Rare Species (current as of September 2018)

TABLE 1A-1: THREATENED OR ENDANGERED SPECIES OF BASTROP COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******AMPHIBIANS******				
Houston Toad	*Anaxyrus houstonensis*	endemic; sandy substrate, water in pools, ephemeral pools, stock tanks; breeds in spring especially after rains; burrows in soil of adjacent uplands when inactive; breeds February-June; associated with soils of the Sparta, Carrizo, Goliad, Queen City, Recklaw, Weches, and Willis geologic formations	LE	E
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Henslow's Sparrow	*Ammodramus henslowii*	wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern	*Sterna antillarum athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Red Knot	*Calidris canutus rufa*	Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knot's prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San	LT	

Common Name	Scientific Name	Description	Federal Status	State Status
		Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore.		
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
Wood Stork	*Mycteria americana*	forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
******CRUSTACEANS******				
A crayfish	*Procambarus texanus*	ponds		
******FISHES******				
Blue sucker	*Cycleptus elongatus*	larger portions of major rivers in Texas; usually in channels and flowing pools with a moderate current; bottom type usually of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T
Guadalupe bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
******MAMMALS******				
Cave myotis bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Elliot's short-tailed shrew	*Blarina hylophaga hylophaga*	sandy areas in live oak mottes, grassy areas with a Loblolly pine (Pinus taeda) overstory, and grassy areas near Post oak (Quercus stellata) stands; burrows extensively under leaf litter, logs, and into soil, but ground cover is not required; needs soft damp soils for ease of burrowing		
Plains spotted skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				

Common Name	Scientific Name	Description	Federal Status	State Status
Texas garter snake	*Thamnophis sirtalis annectens*	wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas horned lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber rattlesnake	*Crotalus horridus*	swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T
******PLANTS******				
Green beebalm	*Monarda viridissima*	Endemic perennial herb of the Carrizo Sands; deep, well-drained sandy soils in openings of post oak woodlands; flowers white.		
Navasota ladies'-tresses	*Spiranthes parksii*	Texas endemic; openings in post oak woodlands in sandy loams along upland drainages or intermittent streams, often in areas with suitable hydrologic factors, such as a perched water table associated with the underlying claypan; flowering populations fluctuate widely from year to year, an individual plant does not flower every year; flowering late October-early November (-early December)	LE	E
Sandhill woollywhite	*Hymenopappus carrizoanus*	Texas endemic; disturbed or open areas in grasslands and post oak woodlands on deep sands derived from the Carrizo Sand and similar Eocene formations; flowering April-June		
Shinner's sunflower	*Helianthus occidentalis ssp plantagineus*	mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country		

TABLE 1A-2: THREATENED OR ENDANGERED SPECIES OF BLANCO COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******AMPHIBIANS******				
Blanco River Springs Salamander	*Eurycea pterophila*	subaquatic; springs and caves in the Blanco River drainage		
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapilla*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous & broad-leaved shrubs & trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
Zone-tailed Hawk	*Buteo albonotatus*	arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions		T
******FISHES******				
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		

Common Name	Scientific Name	Description	Federal Status	State Status
Headwater catfish	*Ictalurus lupus*	originally throughout streams of the Edwards Plateau and the Rio Grande basin, currently limited to Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers		
******INSECTS******				
A mayfly	*Allenhyphes michaeli*	TX Hill Country; mayflies distinguished by aquatic larval stage; adult stage generally found in shoreline vegetation		
Disjunct crawling water beetle	*Haliplus nitens*	unknown, maybe shallow water		
******MAMMALS******				
Black Bear	*Ursus americanus*	bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened		T
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Gray wolf	*Canis lupus*	extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands	LE	E
Llano pocket gopher	*Geomys texensis texensis*	found in deep, brown loamy sands or gravelly sandy loams and is isolated from other species of pocket gophers by intervening shallow stony to gravelly clayey soils		
Plains spotted skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Golden orb	*Quadrula aurea*	sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins	C	T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fatmucket	*Lampsilis bracteata*	streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water; Colorado and Guadalupe River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Spot-tailed earless lizard	*Holbrookia lacerata*	central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid underground		
Texas garter snake	*Thamnophis sirtalis annectens*	wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas horned lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
******PLANTS******				
Granite spiderwort	*Tradescantia pedicellata*	Texas endemic; mostly in fractures on outcrops of granite, gneiss, and similar igneous and metamorphic rocks, or in early successional grasslands or forb-dominated assemblages on well-drained, sandy to gravelly soils derived from same; flowering at least April-May		

Common Name	Scientific Name	Description	Federal Status	State Status
Hill Country wild-mercury	*Argythamnia aphoroides*	Texas endemic; mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes; flowering April-May with fruit persisting until midsummer		
Llano butterweed	*Packera texensis*	Endemic to Llano Uplift of Edwards Plateau; granite sands; arises quickly from evergreen winter rosettes during January rains; flowers Feb-Mar.		

TABLE 1A-3: THREATENED OR ENDANGERED SPECIES OF BURNET COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******ARACHNIDS******				
Bee Creek Cave harvestman	*Texella reddelli*	small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson counties	LE	
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter, hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapilla*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer	LE	E
Interior Least Tern	*Sterna antillarum athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio	LE	E

Common Name	Scientific Name	Description	Federal Status	State Status
		counties		
******CRUSTACEANS******				
An amphipod	*Stygobromus russelli*	subterranean waters, usually in caves and limestone aquifers; resident of numerous caves in ca. 10 counties of the Edwards Plateau		
Bifurcated cave amphipod	*Stygobromus bifurcatus*	found in cave pools		
******FISHES******				
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
Headwater catfish	*Ictalurus lupus*	originally throughout streams of the Edwards Plateau and the Rio Grande basin, currently limited to Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers		
******INSECTS******				
Disjunct crawling water beetle	*Haliplus nitens*	unknown, maybe shallow water		
******MAMMALS******				
Cave myotis bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Gray wolf	*Canis lupus*	extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands	LE	E
Llano pocket gopher	*Geomys texensis texensis*	found in deep, brown loamy sands or gravelly sandy loams and is isolated from other species of pocket gophers by intervening shallow stony to gravelly clayey soils		
Plains spotted skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fatmucket	*Lampsilis bracteata*	streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water; Colorado and Guadalupe River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Concho water snake	*Nerodia paucimaculata*	Texas endemic; Concho and Colorado river systems; shallow fast-flowing water with a rocky or gravelly substrate preferred; adults can be found in deep water with mud bottoms; breeding March-October	DL	
Spot-tailed earless lizard	*Holbrookia lacerata*	central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates;		

Common Name	Scientific Name	Description	Federal Status	State Status
		eggs laid underground		
Texas garter snake	*Thamnophis sirtalis annectens*	wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas horned lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
******PLANTS******				
Basin bellflower	*Campanula reverchonii*	Texas endemic; among scattered vegetation on loose gravel, gravelly sand, and rock outcrops on open slopes with exposures of igneous and metamorphic rocks; may also occur on sandbars and other alluvial deposits along major rivers; flowering May-July		
Edwards Plateau cornsalad	*Valerianella texana*	very shallow, well-drained, but seasonally moist gravelly-sandy soils derived from igneous or metamorphic rocks, often along the downslope margin of rock outcrops, in full sun or in partial shade of oak-juniper woodlands; more likely encountered in early successional areas; population numbers fluctuate considerably from year to year, with higher numbers following winters with higher rains and/or moderate temperatures; peak flowering/fruiting mid-March–late April, stems wither and disappear by the beginning of May		
Enquist's sandmint	*Brazoria enquistii*	Texas endemic; primarily on sand banks in and along beds of streams that drain granitic or gneissic landscapes; flowering/fruiting April-June		
Granite spiderwort	*Tradescantia pedicellata*	Texas endemic; mostly in fractures on outcrops of granite, gneiss, and similar igneous and metamorphic rocks, or in early successional grasslands or forb-dominated assemblages on well-drained, sandy to gravelly soils derived from same; flowering at least April-May		
Rock quillwort	*Isoetes lithophila*	Texas endemic; rooted in sand and gravel under shallow water of seasonal pools (vernal pools) that develop during rainy seasons in small, shallow, unshaded basins on barren outcrops of granite and gneiss; sporulating in late winter and spring, and opportunistically in other seasons following heavy rainfall		

TABLE 1A-4: THREATENED OR ENDANGERED SPECIES OF COLORADO COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******AMPHIBIANS******				
Houston Toad	*Anaxyrus houstonensis*	endemic; sandy substrate, water in pools, ephemeral pools, stock tanks; breeds in spring especially after rains; burrows in soil of adjacent uplands when inactive; breeds February-June; associated with soils of the Sparta, Carrizo, Goliad, Queen City, Recklaw, Weches, and Willis geologic formations	LE	E
Southern Crawfish Frog	*Lithobates areolatus areolatus*	The Southern Crawfish Frog can be found in abandoned crawfish holes and small mammal burrows. This species inhabits moist meadows, pasturelands, pine scrub, and river flood plains. This species spends nearly all of its time in burrows and only leaves the burrow area to breed. Although this species can be difficult to detect due to its reclusive nature, the call of breeding males can be heard over great distances. Eggs are laid and larvae develop in temporary water such as flooded fields, ditches, farm ponds and small lakes. Habitat: Shallow water, Herbaceous Wetland, Riparian, Temporary Pool, Cropland/hedgerow, Grassland/herbaceous, Suburban/orchard, Woodland – Conifer.		
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Attwater's Greater Prairie-chicken	*Tympanuchus cupido attwateri*	this county within historic range; endemic; open prairies of mostly thick grass one to three feet tall; from near sea level to 200 feet along coastal plain on upper two-thirds of Texas coast; males form communal display flocks during late winter-early spring; booming grounds important; breeding February-July	LE	E
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Henslow's Sparrow	*Ammodramus henslowii*	wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern	*Sterna antillarum athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Red Knot	*Calidris canutus rufa*	Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knot's prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and	LT	

Common Name	Scientific Name	Description	Federal Status	State Status
		also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore.		
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
White-faced Ibis	*Plegadis chihi*	prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
White-tailed Hawk	*Buteo albicaudatus*	near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May		T
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
Wood Stork	*Mycteria americana*	forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
******FISHES******				
Blue sucker	*Cycleptus elongatus*	larger portions of major rivers in Texas; usually in channels and flowing pools with a moderate current; bottom type usually of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T
Guadalupe bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
******INSECTS******				
Texas asaphomyian tabanid fly	*Asaphomyia texensis*	globally historic; adults of tabanid spp. found near slow-moving water; eggs laid in masses on leaves or other objects near or over water; larvae are aquatic and predaceous; females of tabanid spp. bite, while males chiefly feed on pollen and nectar; using sight, carbon dioxide, and odor for selection, tabanid spp. lie in wait in shady areas under bushes and trees for a host to happen by		
******MAMMALS******				
Louisiana Black Bear	*Ursus americanus luteolus*	possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	DL	T
Plains spotted skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T

Common Name	Scientific Name	Description	Federal Status	State Status
******REPTILES******				
Texas horned lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber rattlesnake	*Crotalus horridus*	swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T
******PLANTS******				
Coastal gay-feather	*Liatris bracteata*	Texas endemic; coastal prairie grasslands of various types, from salty prairie on low- lying somewhat saline clay loams to upland prairie on nonsaline clayey to sandy loams; flowering in fall		
Shinner's sunflower	*Helianthus occidentalis ssp plantagineus*	mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country		

TABLE 1A-5: THREATENED OR ENDANGERED SPECIES OF FAYETTE COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Henslow's Sparrow	*Ammodramus henslowii*	wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern	*Sterna antillarum athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Red Knot	*Calidris canutus rufa*	Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knot's prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore.	LT	
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E

Wood Stork	*Mycteria americana*	forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
******FISHES******				
Blue sucker	*Cycleptus elongatus*	larger portions of major rivers in Texas; usually in channels and flowing pools with a moderate current; bottom type usually of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T
Guadalupe bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
******MAMMALS******				
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Plains Spotted Skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red Wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Texas horned lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber rattlesnake	*Crotalus horridus*	swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T
******PLANTS******				
Bristle nailwort	*Paronychia setacea*	Flowering vascular plant endemic to eastern southcentral Texas, occurring in sandy soils		
Navasota ladies'-tresses	*Spiranthes parksii*	Texas endemic; openings in post oak woodlands in sandy loams along upland drainages or intermittent streams, often in areas with suitable hydrologic factors, such as a perched water table associated with the underlying claypan; flowering populations fluctuate widely from year to year, an individual plant does not flower every year; flowering late October-early November (-early December)	LE	E
Shinner's sunflower	*Helianthus occidentalis ssp plantagineus*	mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country		

Texas meadow-rue	*Thalictrum texanum*	Texas endemic; mostly found in woodlands and woodland margins on soils with a surface layer of sandy loam, but it also occurs on prairie pimple mounds; both on uplands and creek terraces, but perhaps most common on claypan savannas; soils are very moist during its active growing season; flowering/fruiting (January-) February-May, withering by midsummer, foliage reappears in late fall(November) and may persist through the winter	

TABLE 1A-6: THREATENED OR ENDANGERED SPECIES OF GILLESPIE COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Baird's Sparrow	*Ammodramus bairdii*	shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of State, though winters in Mexico and just across Rio Grande into Texas from Brewster through Hudspeth counties		
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapilla*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.	C	
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
Zone-tailed Hawk	*Buteo albonotatus*	arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions		T
******FISHES******				
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		

Common Name	Scientific Name	Description	Federal Status	State Status
Headwater catfish	*Ictalurus lupus*	originally throughout streams of the Edwards Plateau and the Rio Grande basin, currently limited to Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers		
******MAMMALS******				
Black Bear	*Ursus americanus*	bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened		T
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Gray Wolf	*Canis lupus*	extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands	LE	E
Llano Pocket Gopher	*Geomys texensis texensis*	found in deep, brown loamy sands or gravelly sandy loams and is isolated from other species of pocket gophers by intervening shallow stony to gravelly clayey soils		
Plains spotted skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fatmucket	*Lampsilis bracteata*	streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water; Colorado and Guadalupe River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Spot-tailed earless lizard	*Holbrookia lacerata*	central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid underground		
Texas horned lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
******PLANTS******				
Basin bellflower	*Campanula reverchonii*	Texas endemic; among scattered vegetation on loose gravel, gravelly sand, and rock outcrops on open slopes with exposures of igneous and metamorphic rocks; may also occur on sandbars and other alluvial deposits along major rivers; flowering May-July		
Big red sage	*Salvia pentstemonoides*	Texas endemic; moist to seasonally wet, steep limestone outcrops on seeps within canyons or along creek banks; occasionally on clayey to silty soils of creek banks and terraces, in partial shade to full sun; basal leaves conspicuous for much of the year; flowering June-October		
Canyon rattlesnake-root	*Prenanthes carrii*	Texas endemic; rich humus soils over limestone in upper woodland canyon drainages, upper small spring fed drainages, typically near springs in deep soils around the springs and on limestone shelves, honeycomb rock (porous rock); flowering and fruiting late August-November		

Common Name	Scientific Name	Description	Federal Status	State Status
Correll's false dragon-head	*Physostegia correllii*	wet, silty clay loams on streamsides, in creek beds, irrigation channels and roadside drainage ditches; or seepy, mucky, sometimes gravelly soils along riverbanks or small islands in the Rio Grande; or underlain by Austin Chalk limestone along gently flowing spring-fed creek in central Texas; flowering May-September		
Edwards Plateau cornsalad	*Valerianella texana*	very shallow, well-drained, but seasonally moist gravelly-sandy soils derived from igneous or metamorphic rocks, often along the downslope margin of rock outcrops, in full sun or in partial shade of oak-juniper woodlands; more likely encountered in early successional areas; population numbers fluctuate considerably from year to year, with higher numbers following winters with higher rains and/or moderate temperatures; peak flowering/fruiting mid-March–late April, stems wither and disappear by the beginning of May		
Hill Country wild-mercury	*Argythamnia aphoroides*	Texas endemic; mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes; flowering April-May with fruit persisting until midsummer		
Llano butterweed	*Packera texensis*	Endemic to Llano Uplift of Edwards Plateau; granite sands; arises quickly from evergreen winter rosettes during January rains; flowers Feb-Mar.		
Rock quillwort	*Isoetes lithophila*	Texas endemic; rooted in sand and gravel under shallow water of seasonal pools (vernal pools) that develop during rainy seasons in small, shallow, unshaded basins on barren outcrops of granite and gneiss; sporulating in late winter and spring, and opportunistically in other seasons following heavy rainfall		
Small-headed pipewort	*Eriocaulon koernickianum*	in East Texas, post-oak woodlands and xeric sandhill openings on permanently wet acid sands of upland seeps and hillside seepage bogs, usually in patches of bare sand rather than among dense vegetation or on muck; in Gillespie County, on permanently wet or moist hillside seep on decomposing granite gravel and sand among granite outcrops; flowering/fruiting late May-late June		
Warnock's coral-root	*Hexalectris warnockii*	in leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creekbeds in canyons; in the Trans Pecos in oak-pinyon-juniper woodlands in higher mesic canyons (to 2000 m [6550 ft]), primarily on igneous substrates; in Terrell County under Quercus fusiformis mottes on terrraces of spring-fed perennial streams, draining an otherwise rather xeric limestone landscape; on the Callahan Divide (Taylor County), the White Rock Escarpment (Dallas County), and the Edwards Plateau in oak-juniper woodlands on limestone slopes; in Gillespie County on igneous substrates of the Llano Uplift; flowering June-September; individual plants do not usually bloom in successive years		

TABLE 1A-7: THREATENED OR ENDANGERED SPECIES OF HAYS COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******AMPHIBIANS******				
Barton Springs salamander	*Eurycea sosorum*	dependent upon water flow/quality from the Barton Springs pool of the Edwards Aquifer; known from the outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae, as available; feeds primarily on amphipods	LE	E
Blanco Blind Salamander	*Eurycea robusta*	troglobitic; water-filled subterranean caverns; may inhabit deep levels of the Balcones aquifer to the north and east of the Blanco River		T
Blanco River Springs Salamander	*Eurycea pterophila*	subaquatic; springs and caves in the Blanco River drainage		
San Marcos Salamander	*Eurycea nana*	headwaters of the San Marcos River downstream to ca. ½ mile past IH-35; water over gravelly substrate characterized by dense mats of algae (*Lyng bya*) and aquatic moss (*Leptodictym riparium*), and water temperatures of 21-22 ^{O} C; diet includes amphipods, midge larve, and aquatic snails	LT	T
Texas Blind Salamander	*Eurycea rathbuni*	troglobitic; water-filled subterranean caverns along a six mile stretch of the San Marcos Spring Fault, in the vicinity of San Marcos; eats small invertebrates, including snails, copepods, amphipods, and shrimp	LE	E
******ARACHNIDS******				
Bandit Cave spider	*Cicurina bandida*	very small, subterrestrial, subterranean obligate		
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapilla*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T

Common Name	Scientific Name	Description	Federal Status	State Status
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
Zone-tailed Hawk	*Buteo albonotatus*	arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions		T
******CRUSTACEANS******				
A cave obligate crustaean	*Monodella texana*	subaquatic, subterranean obligate; underground freshwater aquifers		
Balcones Cave amphipod	*Stygobromus balconis*	subaquatic, subterranean obligate amphipod		
Ezell's Cave Amphipod	*Stygobromus flagellatus*	known only from artesian wells		
Texas Cave Shrimp	*Palaemonetes antrorum*	subterranean sluggish streams and pools		
Texas troglobitic water slater	*Lirceolus smithii*	subaquatic, subterranean obligate, aquifer		
******FISHES******				
Fountain Darter	*Etheostoma fonticola*	known only from the San Marcos and Comal rivers; springs and spring-fed streams in dense beds of aquatic plants growing close to bottom, which is normally mucky; feeding mostly diurnal; spawns year-round with August and late winter to early spring peaks	LE	E
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
Ironcolor shiner	*Notropis chalybaeus*	Big Cypress Bayou and Sabine River basins; spawns April-September, eggs sink to bottom of pool; pools and slow runs of low gradient small acidic streams with sandy substrate and clear well vegetated water; feeds mainly on small insects, ingested plant material not digested		
San Marcos Gambusia	*Gambusia georgei*	extinct; endemic; formerly known from upper San Marcos River; restricted to shallow, quiet, mud-bottomed shoreline areas without dense vegetation in thermally constant main channel	LE	E
******INSECTS******				
Comal Springs dryopid beetle	*Stygoparnus comalensis*	dryopids usually cling to objects in a stream; dryopids are sometimes found crawling on stream bottoms or along shores; adults may leave the stream and fly about, especially at night; most dryopid larvae are vermiform and live in soil or decaying wood	LE	E
Comal Springs Riffle Beetle	*Heterelmis comalensis*	Comal and San Marcos Springs	LE	E
Edwards Aquifer Diving Beetle	*Haideoporus texanus*	habitat poorly known; known from an artesian well in Hays County		
Flint's net-spinning caddisfly	*Cheumatopsyche flinti*	very poorly known species with habitat description limited to 'a spring'		
San Marcos Saddle-case Caddisfly	*Protoptila arca*	known from an artesian well in Hays County; locally very abundant; swift, well-oxygenated warm water about 1-2 m deep; larvae and pupal cases abundant on rocks		
Texas austrotinodes caddisfly	*Austrotinodes texensis*	appears endemic to the karst springs and spring runs of the Edwards Plateau region; flow in type locality swift but may drop significantly during periods of little drought; substrate coarse and ranges from cobble and gravel to limestone bedrock; many limestone outcroppings also found along the streams		
******MAMMALS******				

Common Name	Scientific Name	Description	Federal Status	State Status
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Plains Spotted Skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Golden orb	*Quadrula aurea*	sand and gravel in some locations and mud at others; found in lentic and lotic; Guadalupe, San Antonio, Lower San Marcos, and Nueces River basins	C	T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fatmucket	*Lampsilis bracteata*	streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water; Colorado and Guadalupe River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Cagle's Map Turtle	*Graptemys caglei*	endemic; Guadalupe River System; shallow water with swift to moderate flow and gravel or cobble bottom, connected by deeper pools with a slower flow rate and a silt or mud bottom; gravel bar riffles and transition areas between riffles and pools especially important in providing insect prey items; nests on gently sloping sand banks within ca. 30 feet of water's edge		T
Spot-tailed Earless Lizard	*Holbrookia lacerata*	central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid underground		
Texas Garter Snake	*Thamnophis sirtalis annectens*	wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas Horned Lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
******PLANTS******				
Bracted twistflower	*Streptanthus bracteatus*	Texas endemic; shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; several known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations; populations fluctuate widely from year to year, depending on winter rainfall; flowering mid April-late May, fruit matures and foliage withers by early summer	C	
Hill country wild-mercury	*Argythamnia aphoroides*	Texas endemic; mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes; flowering April-May with fruit persisting until midsummer		
Texas wild-rice	*Zizania texana*	Texas endemic; spring-fed river, in clear, cool, swift water mostly less than 1 m deep, with coarse sandy soils rather than finer clays; flowering	LE	E

Common Name	Scientific Name	Description	Federal Status	State Status
		year-round, peaking March-June		
Warnock's coral root	*Hexalectris warnockii*	in leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creekbeds in canyons; in the Trans Pecos in oak-pinyon-juniper woodlands in higher mesic canyons (to 2000 m [6550 ft]), primarily on igneous substrates; in Terrell County under Quercus fusiformis mottes on terrraces of spring-fed perennial streams, draining an otherwise rather xeric limestone landscape; on the Callahan Divide (Taylor County), the White Rock Escarpment (Dallas County), and the Edwards Plateau in oak-juniper woodlands on limestone slopes; in Gillespie County on igneous substrates of the Llano Uplift; flowering June-September; individual plants do not usually bloom in successive years		

TABLE 1A-8: THREATENED OR ENDANGERED SPECIES OF LLANO COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapillus*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous & broad-leaved shrubs & trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer	LE	E
Interior Least Tern	*Sterna antillarum athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E

Common Name	Scientific Name	Description	Federal Status	State Status
Zone-tailed Hawk	*Buteo albonotatus*	arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions		T
******FISHES******				
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
Headwater catfish	*Ictalurus lupus*	originally throughout streams of the Edwards Plateau and the Rio Grande basin, currently limited to Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers		
******MAMMALS******				
Black Bear	*Ursus americanus*	bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened		T
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Gray Wolf	*Canis lupus*	extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands	LE	E
Llano Pocket Gopher	*Geomys texensis texensis*	found in deep, brown loamy sands or gravelly sandy loams and is isolated from other species of pocket gophers by intervening shallow stony to gravelly clayey soils		
Plains Spotted Skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red Wolf	*Canis Rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fatmucket	*Lampsilis bracteata*	streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water; Colorado and Guadalupe River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Spot-tailed Earless Lizard	*Holbrookia lacerata*	central & southern Texas & adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other		

Common Name	Scientific Name	Description	Federal Status	State Status
		obstructions, including disturbed areas; eats small invertebrates; eggs laid underground		
Texas Garter Snake	*Thamnophis sirtalis annectens*	wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas Horned Lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
******PLANTS******				
Basin bellflower	*Campanula reverchonii*	Texas endemic; among scattered vegetation on loose gravel, gravelly sand, and rock outcrops on open slopes with exposures of igneous and metamorphic rocks; may also occur on sandbars and other alluvial deposits along major rivers; flowering May-July		
Edwards Plateau Cornsalad	*Valerianellla texana*	very shallow, well-drained, but seasonally moist gravelly-sandy soils derived from igneous or metamorphic rocks, often along the downslope margin of rock outcrops, in full sun or in partial shade of oak-juniper woodlands; more likely encountered in early successional areas; population numbers fluctuate considerably from year to year, with higher numbers following winters with higher rains and/or moderate temperatures; peak flowering/fruiting mid-March–late April, stems wither and disappear by the beginning of May		
Elmendorf's Onion	*Allium elmendorfii*	Texas endemic; grassland openings in oak woodlands on deep, loose, well-drained sands; in Coastal Bend, on Pleistocene barrier island ridges and Holocene Sand Sheet that support live oak woodlands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations; one anomalous specimen found on Llano Uplift in wet pockets of granitic loam; flowering March-April, May		
Enquist's sandmint	*Brazoria enquistii*	Texas endemic ; primarily on sand banks in and along beds of streams that drain granitic or gneissic landscapes; flowering/fruiting April-June		
Granite spiderwort	*Tradescantia pedicellata*	Texas endemic; mostly in fractures on outcrops of granite, gneiss, and similar igneous and metamorphic rocks, or in early successional grasslands or forb-dominated assemblages on well-drained, sandy to gravelly soils derived from same; flowering at least April-May		
Llano butterweed	*Packera texensis*	Endemic to Llano Uplift of Edwards Plateau; granite sands; arises quickly from evergreen winter rosettes during January rains; flowers Feb-March.		
Rock quillwort	*Isoetes lithophila*	Texas endemic; rooted in sand and gravel under shallow water of seasonal pools (vernal pools) that develop during rainy seasons in small, shallow, unshaded basins on barren outcrops of granite and gneiss; sporulating in late winter and spring, and opportunistically in other seasons following heavy rainfall.		

TABLE 1A-9: THREATENED OR ENDANGERED SPECIES OF MATAGORDA COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black Rail	*Laterallus jamaicensis*	salt, brackish, and freshwater marshes, pond borders, wet meadows, and grassy swamps; nests in or along edge of marsh, sometimes on damp ground, but usually on mat of previous year's dead grasses; nest usually hidden in marsh grass or at base of Salicornia	NL	
Brown Pelican	*Pelecanus occidentalis*	largely coastal and near shore areas, where it roosts and nests on islands and spoil banks	DL	
Eskimo Curlew	*Numenius borealis*	historic; nonbreeding: grasslands, pastures, plowed fields, and less frequently, marshes and mudflats	LE	E
Henslow's Sparrow	*Ammodramus henslowii*	wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	open country, especially savanna and open woodland, and sometimes in very barren areas; grassy plains and valleys with scattered mesquite, yucca, and cactus; nests in old stick nests of other bird species	LE	E
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Piping Plover	*Charadrius melodus*	wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats	LT	T
Red Knot	*Calidris canutus rufa*	Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knot's prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore.	LT	
Reddish Egret	*Egretta rufescens*	resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Snowy Plover	*Charadrius alexandrinus*	formerly an uncommon breeder in the Panhandle; potential migrant; winter along coast		

Common Name	Scientific Name	Description	Federal Status	State Status
Sooty Tern	*Sterna fuscata*	predominately 'on the wing'; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July		T
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Western Snowy Plover	*Charadrius alexandrinus nivosus*	uncommon breeder in the Panhandle; potential migrant; winter along coast		
White-faced Ibis	*Plegadis chihi*	prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
White-tailed Hawk	*Buteo albicaudatus*	near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May		T
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
Wood Stork	*Mycteria americana*	forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
******CRUSTACEANS******				
A crayfish	*Cambarellus texanus*	shallow water; benthic, burrowing in or using soil; apparently tolerant of warmer waters; prefers standing water of ditches in which there is emergent vegetation; will burrow in dry periods; detritivore		
******FISHES******				
American Eel	*Anguilla rostrata*	coastal waterways below reservoirs to gulf; spawns January to February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; most aquatic habitats with access to ocean, muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries; diet varies widely, geographically, and seasonally		
Blue sucker	*Cycleptus elongatus*	larger portions of major rivers in Texas; usually in channels and flowing pools with a moderate current; bottom type usually of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T
Smalltooth sawfish	*Pristis pectinata*	different life history stages have different patterns of habitat use; young found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft (10 m); in sheltered bays, on shallow banks, and in estuaries or river mouths; adult sawfish are encountered in various habitat types (mangrove, reef, seagrass, and coral), in varying salinity regimes and temperatures, and at various water depths, feed on a variety of fish species and crustaceans	LE	E
******INSECTS******				
Gulf Coast clubtail	*Gomphus modestus*	medium river, moderate gradient,and streams with silty sand or rocky bottoms; adults forage in trees, males perch near riffles to wait for females, larvae overwinter; flight season late Apr - late Jun		
******MAMMALS******				
Louisiana Black Bear	*Ursus americanus luteolus*	possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	DL	T
Ocelot	*Leopardus pardalis*	dense chaparral thickets; mesquite-thorn scrub and live oak mottes; avoids open areas; breeds and raises young June-November	LE	E
Plains Spotted Skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red Wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E

Common Name	Scientific Name	Description	Federal Status	State Status
West Indian Manatee	*Trichechus manatus*	Gulf and bay system; opportunistic, aquatic herbivore	LT	E
******MOLLUSKS******				
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Atlantic Hawksbill Sea Turtle	*Eretmochelys imbricata*	Gulf and bay system, warm shallow waters especially in rocky marine environments, such as coral reefs and jetties, juveniles found in floating mats of sea plants; feed on sponges, jellyfish, sea urchins, molluscs, and crustaceans, nests April through November	LE	E
Green sea turtle	*Chelonia mydas*	Gulf and bay system; shallow water seagrass beds, open water between feeding and nesting areas, barrier island beaches; adults are herbivorous feeding on sea grass and seaweed; juveniles are omnivorous feeding initially on marine invertebrates, then increasingly on sea grasses and seaweeds; nesting behavior extends from March to October, with peak activity in May and June	LT	T
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Gulf and bay system, adults stay within the shallow waters of the Gulf of Mexico; feed primarily on crabs, but also snails, clams, other crustaceans and plants, juveniles feed on sargassum and its associated fauna; nests April through August	LE	E
Leatherback Sea Turtle	*Dermochelys coriacea*	Gulf and bay systems, and widest ranging open water reptile; omnivorous, shows a preference for jellyfish; in the US portion of their western Atlantic nesting territories, nesting season ranges from March to August	LE	E
Loggerhead Sea Turtle	*Caretta caretta*	Gulf and bay system primarily for juveniles, adults are most pelagic of the sea turtles; omnivorous, shows a preference for mollusks, crustaceans, and coral; nests from April through November	LT	T
Texas Diamondback Terrapin	*Malaclemys terrapin littoralis*	coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide		
Texas Horned Lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Texas scarlet snake	*Cemophora coccinea lineri*	mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T
Texas Tortoise	*Gopherus berlandieri*	open brush with a grass understory is preferred; open grass and bare ground are avoided; when inactive occupies shallow depressions at base of bush or cactus, sometimes in underground burrows or under objects; longevity greater than 50 years; active March-November; breeds April-November		T
Timber Rattlesnake	*Crotalus horridus*	swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T
****** PLANTS******				
Coastal Gay-Feather	*Liatris bracteata*	Texas endemic; coastal prairie grasslands of various types, from salty prairie on low- lying somewhat saline clay loams to upland prairie on nonsaline clayey to sandy loams; flowering in fall		
Panicled indigobush	*Amorpha paniculata*	A stout shrub, 3 m (9 ft) tall that grows in acid seep forests, peat bogs, wet floodplain forests, and seasonal wetlands on the edge of Saline Prairies in East Texas. It is distinguished from other Amorpha species by its fuzzy		

Common Name	Scientific Name	Description	Federal Status	State Status
		leaflets with prominent raised veins underneath, and the flower panicles, which are 8 to 16 inches long and slender, held above the foliage. Perennial; Flowering summer		
Shinner's sunflower	*Helianthus occidentalis ssp plantagineus*	mostly in prairies on the Coastal Plain, with several slightly disjunct populations in the Pineywoods and South Texas Brush Country		
Threeflower broomweed	*Thurovia triflora*	Texas endemic; near coast in sparse, low vegetation on a veneer of light colored silt or fine sand over saline clay along drier upper margins of ecotone between between salty prairies and tidal flats; further inland associated with vegetated slick spots on prairie mima mounds; flowering September-November		

TABLE 1A-10: THREATENED OR ENDANGERED SPECIES OF MILLS COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapilla*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer	LE	E
Interior Least Tern	*Sterna antillarum athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
******FISHES******				
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
******MAMMALS******				
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of		

		Panhandle during winter; opportunistic insectivore		
Gray Wolf	*Canis lupus*	extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands	LE	E
Llano pocket gopher	*Geomys texensis texensis*	found in deep, brown loamy sands or gravelly sandy loams and is isolated from other species of pocket gophers by intervening shallow stony to gravelly clayey soils		
Red Wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Concho Water Snake	*Nerodia Paucimaculata*	Texas endemic; Concho and Colorado river systems; shallow fast-flowing water with a rocky or gravelly substrate preferred; adults can be found in deep water with mud bottoms; breeding March-October	DL	
Texas Horned Lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
******PLANTS******				
Hill Country Wild-Mercury	*Argythamnia Aphoroides*	Texas endemic; mostly in bluestem-grama grasslands associated with plateau live oak woodlands on shallow to moderately deep clays and clay loams over limestone on rolling uplands, also in partial shade of oak-juniper woodlands in gravelly soils on rocky limestone slopes; flowering April-May with fruit persisting until midsummer		

TABLE 1A-11: THREATENED OR ENDANGERED SPECIES OF SAN SABA COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Baird's Sparrow	*Ammodramus bairdii*	shortgrass prairie with scattered low bushes and matted vegetation; mostly migratory in western half of State, though winters in Mexico and just across Rio Grande into Texas from Brewster through Hudspeth counties		
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapilla*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer	LE	E
Interior Least Tern	*Sterna Antillarum Athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
Zone-tailed Hawk	*Buteo albonotatus*	arid open country, including open deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions		T

Common Name	Scientific Name	Description	Federal Status	State Status
******CRUSTACEANS******				
Reddell's cave amphipod	*Stygobromus reddelli*	subterranean obligate; small cave streams		
******FISHES******				
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
Headwater catfish	*Ictalurus lupus*	originally throughout streams of the Edwards Plateau and the Rio Grande basin, currently limited to Rio Grande drainage, including Pecos River basin; springs, and sandy and rocky riffles, runs, and pools of clear creeks and small rivers		
Sharpnose shiner	*Notropis oxyrhynchus*	endemic to Brazos River drainage; also, apparently introduced into adjacent Colorado River drainage; large turbid river, with bottom a combination of sand, gravel, and clay-mud	LE	
******MAMMALS******				
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Gray Wolf	*Canis lupus*	extirpated; formerly known throughout the western two-thirds of the state in forests, brushlands, or grasslands	LE	E
Llano Pocket Gopher	*Geomys texensis texensis*	found in deep, brown loamy sands or gravelly sandy loams and is isolated from other species of pocket gophers by intervening shallow stony to gravelly clayey soils		
Red Wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quincuncina mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fatmucket	*Lampsilis bracteata*	streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water; Colorado and Guadalupe River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Concho water snake	*Nerodia paucimaculata*	Texas endemic; Concho and Colorado river systems; shallow fast-flowing water with a rocky or gravelly substrate preferred; adults can be found in deep water with mud bottoms; breeding March-October	DL	
Spot-tailed earless lizard	*Holbrookia lacerata*	central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid underground		
Texas horned lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
******PLANTS******				

Common Name	Scientific Name	Description	Federal Status	State Status
Basin bellflower	*Campanula reverchonii*	Texas endemic; among scattered vegetation on loose gravel, gravelly sand, and rock outcrops on open slopes with exposures of igneous and metamorphic rocks; may also occur on sandbars and other alluvial deposits along major rivers; flowering May-July		

TABLE 1A-12: THREATENED OR ENDANGERED SPECIES OF TRAVIS COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******AMPHIBIANS******				
Austin Blind Salamander	*Eurycea waterlooensis*	mostly restricted to subterranean cavities of the Edwards Aquifer; dependent upon water flow/quality from the Barton Springs segment of the Edwards Aquifer; only known from the outlets of Barton Springs (Sunken Gardens (Old Mill) Spring, Eliza Spring, and Parthenia (Main) Spring which forms Barton Springs Pool); feeds on amphipods, ostracods, copepods, plant material, and (in captivity) a wide variety of small aquatic invertebrates	LE	E
Barton Springs Salamander	*Eurycea sosorum*	dependent upon water flow/quality from the Barton Springs pool of the Edwards Aquifer; known from the outlets of Barton Springs and subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae, as available; feeds primarily on amphipods	LE	E
Jollyville Plateau Salamander	*Eurycea tonkawae*	known from springs and waters of some caves north of the Colorado River	LT	
Pedernales River Springs Salamander	*Eurycea sp. 6*	endemic; known only from springs		
******ARACHNIDS******				
Bandit Cave Spider	*Cicurina bandida*	very small, subterrestrial, subterranean obligate		
Bee Creek Cave harvestman	*Texella reddelli*	small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson counties	LE	
Bone Cave Harvestman	*Texella reyesi*	small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson counties; weakly differentiated from Texella reddelli	LE	
Tooth Cave Pseudoscorpion	*Tartarocreagris texana*	small, cave-adapted pseudoscorpion known from small limestone caves of the Edwards Plateau	LE	
Tooth Cave Spider	*Neoleptoneta myopica*	very small, cave-adapted, sedentary spider	LE	
Warton's cave meshweaver	*Cicurina wartoni*	very small, cave-adapted spider		
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapillus*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-	LE	E

Common Name	Scientific Name	Description	Federal Status	State Status
		leaved trees and shrubs; nesting late March-early summer		
Interior Least Tern	*Sterna antillarum athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Red Knot	*Calidris canutus rufa*	Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knot's prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore.	LT	
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
******CRUSTACEANS******				
An Amphipod	*Stygobromus russelli*	subterranean waters, usually in caves & limestone aquifers; resident of numerous caves in ca. 10 counties of the Edwards Plateau		
Balcones Cave amphipod	*Stygobromus balconis*	subaquatic, subterranean obligate amphipod		
Bifurcated Cave Amphipod	*Stygobromus bifurcatus*	found in cave pools		
******FISHES******				
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
Smalleye shiner	*Notropis buccula*	endemic to upper Brazos River system and its tributaries (Clear Fork and Bosque); apparently introduced into adjacent Colorado River drainage; medium to large prairie streams with sandy substrate and turbid to clear warm water; presumably eats small	LE	

Common Name	Scientific Name	Description	Federal Status	State Status
		aquatic invertebrates		
******INSECTS******				
Kretschmarr Cave Mold Beetle	*Texamaurops reddelli*	small, cave-adapted beetle found under rocks buried in silt; small, Edwards Limestone caves in of the Jollyville Plateau, a division of the Edwards Plateau	LE	
Tooth Cave Blind Rove Beetle	*Cylindropsis sp. 1*	one specimen collected from Tooth Cave; only known North American collection of this genus		
Tooth Cave Ground Beetle	*Rhadine persephone*	resident, small, cave-adapted beetle found in small Edwards Limestone caves in Travis and Williamson counties	LE	
******MAMMALS******				
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Plains Spotted Skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red Wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fatmucket	*Lampsilis bracteata*	streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water; Colorado and Guadalupe River basins	C	T
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Spot-tailed Earless Lizard	*Holbrookia lacerata*	central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid underground		
Texas Garter Snake	*Thamnophis sirtalis annectens*	wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas Horned Lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
****** PLANTS******				
Basin bellflower	*Campanula reverchonii*	Texas endemic; among scattered vegetation on loose gravel, gravelly sand, and rock outcrops on open slopes with exposures of igneous and metamorphic rocks; may also occur on sandbars and other alluvial deposits along major rivers; flowering May-July		
Boerne bean	*Phaseolus texensis*	Narrowly endemic to rocky canyons in eastern and southern Edwards Plateau occurring on limestone soils in mixed woodlands, on limestone cliffs and outcrops, frequently along creeks.		
Bracted twistflower	*Streptanthus bracteatus*	Texas endemic; shallow, well-drained gravelly clays and clay loams	C	

Common Name	Scientific Name	Description	Federal Status	State Status
		over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; several known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations; populations fluctuate widely from year to year, depending on winter rainfall; flowering mid April-late May, fruit matures and foliage withers by early summer		
Correll's false dragon-head	*Physostegia correllii*	wet, silty clay loams on streamsides, in creek beds, irrigation channels and roadside drainage ditches; or seepy, mucky, sometimes gravelly soils along riverbanks or small islands in the Rio Grande; or underlain by Austin Chalk limestone along gently flowing spring-fed creek in central Texas; flowering May-September		
Texabama croton	*Croton alabamensis var. texensis*	Texas endemic; in duff-covered loamy clay soils on rocky slopes in forested, mesic limestone canyons; locally abundant on deeper soils on small terraces in canyon bottoms, often forming large colonies and dominating the shrub layer; scattered individuals are occasionally on sunny margins of such forests; also found in contrasting habitat of deep, friable soils of limestone uplands, mostly in the shade of evergreen woodland mottes; flowering late February-March; fruit maturing and dehiscing by early June		
Warnock's coral-root	*Hexalectris warnockii*	in leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creekbeds in canyons; in the Trans Pecos in oak-pinyon-juniper woodlands in higher mesic canyons (to 2000 m [6550 ft]), primarily on igneous substrates; in Terrell County under Quercus fusiformis mottes on terrraces of spring-fed perennial streams, draining an otherwise rather xeric limestone landscape; on the Callahan Divide (Taylor County), the White Rock Escarpment (Dallas County), and the Edwards Plateau in oak-juniper woodlands on limestone slopes; in Gillespie County on igneous substrates of the Llano Uplift; flowering June-September; individual plants do not usually bloom in successive years		

TABLE 1A-13: THREATENED OR ENDANGERED SPECIES OF WHARTON COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******AMPHIBIANS******				
Southern Crawfish Frog	*Lithobates areolatus areolatus*	The Southern Crawfish Frog can be found in abandoned crawfish holes and small mammal burrows. This species inhabits moist meadows, pasturelands, pine scrub, and river flood plains. This species spends nearly all of its time in burrows and only leaves the burrow area to breed. Although this species can be difficult to detect due to its reclusive nature, the call of breeding males can be heard over great distances. Eggs are laid and larvae develop in temporary water such as flooded fields, ditches, farm ponds and small lakes. Habitat: Shallow water, Herbaceous Wetland, Riparian, Temporary Pool, Cropland/hedgerow, Grassland/herbaceous, Suburban/orchard, Woodland – Conifer.		
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Attwater's Greater Prairie-chicken	*Tympanuchus cupido attwateri*	this county within historic range; endemic; open prairies of mostly thick grass one to three feet tall; from near sea level to 200 feet along coastal plain on upper two-thirds of Texas coast; males form communal display flocks during late winter-early spring; booming grounds important; breeding February-July	LE	E
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Henslow's Sparrow	*Ammodramus henslowii*	wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern	*Sterna antillarum athalassos*	subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.	DL	T
Red Knot	*Calidris canutus rufa*	Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knot's prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches,	LT	

Common Name	Scientific Name	Description	Federal Status	State Status
		herbaceous wetland, and Tidal flat/shore.		
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
White-faced Ibis	*Plegadis chihi*	prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
White-tailed Hawk	*Buteo albicaudatus*	near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral; breeding March-May		T
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
Wood Stork	*Mycteria americana*	forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
******CRUSTACEANS******				
A crayfish	*Cambarellus texanus*	shallow water; benthic, burrowing in or using soil; apparently tolerant of warmer waters; prefers standing water of ditches in which there is emergent vegetation; wll burrow in dry periods; detritivore		
******FISHES******				
American Eel	*Anguilla rostrata*	coastal waterways below reservoirs to gulf; spawns January to February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; most aquatic habitats with access to ocean, muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries; diet varies widely, geographically, and seasonally		
Blue sucker	*Cycleptus elongatus*	larger portions of major rivers in Texas; usually in channels and flowing pools with a moderate current; bottom type usually of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T
Sharpnose shiner	*Notropis oxyrhynchus*	endemic to Brazos River drainage; also, apparently introduced into adjacent Colorado River drainage; large turbid river, with bottom a combination of sand, gravel, and clay-mud	LE	
******MAMMALS******				
Louisiana Black Bear	*Ursus americanus luteolus*	possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	DL	T
Plains Spotted Skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River	C	T

Common Name	Scientific Name	Description	Federal Status	State Status
		basins		
Texas pimpleback	*Quadrula petrina*	mud, gravel and sand substrates, generally in areas with slow flow rates; Colorado and Guadalupe river basins	C	T
******REPTILES******				
Texas Horned Lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber Rattlesnake	*Crotalus horridus*	swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

TABLE 1A-14: THREATENED OR ENDANGERED SPECIES OF WILLIAMSON COUNTY

Common Name	Scientific Name	Description	Federal Status	State Status
******AMPHIBIANS******				
Georgetown Salamander	*Eurycea naufragia*	endemic; known from springs and waters in and around town of Georgetown in Williamson County	LT	
Jollyville Plateau Salamander	*Eurycea tonkawae*	known from springs and waters of some caves north of the Colorado River	LT	
Salado Springs salamander	*Eurycea chisholmensis*	endemic; surface springs and subterranean waters of the Salado Springs system along Salado Creek	LT	
Southern Crawfish Frog	*Lithobates areolatus areolatus*	The Southern Crawfish Frog can be found in abandoned crawfish holes and small mammal burrows. This species inhabits moist meadows, pasturelands, pine scrub, and river flood plains. This species spends nearly all of its time in burrows and only leaves the burrow area to breed. Although this species can be difficult to detect due to its reclusive nature, the call of breeding males can be heard over great distances. Eggs are laid and larvae develop in temporary water such as flooded fields, ditches, farm ponds and small lakes. Habitat: Shallow water, Herbaceous Wetland, Riparian, Temporary Pool, Cropland/hedgerow, Grassland/herbaceous, Suburban/orchard, Woodland – Conifer.		
******ARACHNIDS******				
Bandit Cave spider	*Cicurina bandida*	very small, subterrestrial, subterranean obligate		
Bone Cave Harvestman	*Texella reyesi*	small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson counties; weakly differentiated from Texella reddelli	LE	
******BIRDS******				
American Peregrine Falcon	*Falco peregrinus anatum*	year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DL	
Bald Eagle	*Haliaeetus leucocephalus*	found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	DL	T
Black-capped Vireo	*Vireo atricapilla*	oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer	DL	E
Golden-cheeked Warbler	*Setophaga chrysoparia*	juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer	LE	E
Mountain Plover	*Charadrius montanus*	breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous		
Peregrine Falcon	*Falco peregrinus*	both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed	DL	T

Common Name	Scientific Name	Description	Federal Status	State Status
		in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.		
Red Knot	*Calidris canutus rufa*	Red knots migrate long distances in flocks northward through the contiguous United States mainly April-June, southward July-October. A small plump-bodied, short-necked shorebird that in breeding plumage, typically held from May through August, is a distinctive and unique pottery orange color. Its bill is dark, straight and, relative to other shorebirds, short-to-medium in length. After molting in late summer, this species is in a drab gray-and-white non-breeding plumage, typically held from September through April. In the non-breeding plumage, the knot might be confused with the omnipresent Sanderling. During this plumage, look for the knot's prominent pale eyebrow and whitish flanks with dark barring. The Red Knot prefers the shoreline of coast and bays and also uses mudflats during rare inland encounters. Primary prey items include coquina clam (Donax spp.) on beaches and dwarf surf clam (Mulinia lateralis) in bays, at least in the Laguna Madre. Wintering Range includes- Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, San Patricio, and Willacy. Habitat: Primarily seacoasts on tidal flats and beaches, herbaceous wetland, and Tidal flat/shore.	LT	
Sprague's Pipit	*Anthus spragueii*	only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.		
Western Burrowing Owl	*Athene cunicularia hypugaea*	open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows		
Whooping Crane	*Grus americana*	potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties	LE	E
******CRUSTACEANS******				
An amphipod	*Stygobromus russelli*	subterranean waters, usually in caves and limestone aquifers; resident of numerous caves in ca. 10 counties of the Edwards Plateau		
Bifurcated cave amphipod	*Stygobromus bifurcatus*	found in cave pools		
Ezell's cave amphipod	*Stygobromus flagellatus*	known only from artesian wells		
******FISHES******				
Guadalupe Bass	*Micropterus treculii*	endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system		
Sharpnose Shiner	*Notropis oxyrhynchus*	endemic to Brazos River drainage; also, apparently introduced into adjacent Colorado River drainage; large turbid river, with bottom a combination of sand, gravel, and clay-mud	LE	
Smalleye Shiner	*Notropis buccula*	endemic to upper Brazos River system and its tributaries (Clear Fork and Bosque); apparently introduced into adjacent Colorado River drainage; medium to large prairie streams with sandy substrate and turbid to clear warm water; presumably eats small aquatic invertebrates	LE	
******INSECTS******				
A mayfly	*Pseudocentroptiloides morihari*	mayflies distinguished by aquatic larval stage; adult stage generally found in shoreline vegetation		
Coffin Cave Mold Beetle	*Batrisodes texanus*	resident, small, cave-adapted beetle found in small Edwards Limestone caves in Travis and Williamson counties	LE	
Tooth Cave Ground Beetle	*Rhadine persephone*	resident, small, cave-adapted beetle found in small Edwards Limestone caves in Travis and Williamson counties	LE	
******MAMMALS******				

Common Name	Scientific Name	Description	Federal Status	State Status
Cave Myotis Bat	*Myotis velifer*	colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (*Hirundo pyrrhonota*) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore		
Plains Spotted Skunk	*Spilogale putorius interrupta*	catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Red wolf	*Canis rufus*	extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
******MOLLUSKS******				
False spike mussel	*Quadrula mitchelli*	possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins		T
Smooth pimpleback	*Quadrula houstonensis*	small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	C	T
Texas fawnsfoot	*Truncilla macrodon*	little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins	C	T
******REPTILES******				
Spot-tailed Earless Lizard	*Holbrookia lacerata*	central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid underground		
Texas Garter Snake	*Thamnophis sirtalis annectens*	wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August		
Texas Horned Lizard	*Phrynosoma cornutum*	open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber Rattlesnake	*Crotalus horridus*	swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T
******PLANTS******				
Elmendorf's onion	*Allium elmendorfii*	Texas endemic; grassland openings in oak woodlands on deep, loose, well-drained sands; in Coastal Bend, on Pleistocene barrier island ridges and Holocene Sand Sheet that support live oak woodlands; to the north it occurs in post oak-black hickory-live oak woodlands over Queen City and similar Eocene formations; one anomalous specimen found on Llano Uplift in wet pockets of granitic loam; flowering March-April, May		

APPENDIX 1B

THE HIGHLAND LAKES: HISTORY AND SOCIAL AND ECONOMIC IMPORTANCE

This Appendix was developed by the Central Texas Water Coalition, Inc. as an update of the Appendix 1B included in the 2016 Region K Plan. A list of reference documents, source materials, and entities who provided assistance and data for this Appendix is provided at its conclusion.

Brief History of the Highland Lakes System

The Highland Lakes system is comprised of two water storage reservoirs, Lakes Buchanan and Travis, and four pass-through reservoirs, Lakes Inks, LBJ, Marble Falls and Austin. During the construction of the dams and development of the Highland Lakes system, the Lower Colorado River Authority (LCRA) acquired large tracts of land that surround the reservoir system. LCRA is authorized to develop, manage, and promote the use of these lands for parks, recreational facilities and natural science laboratories and to promote the preservation of fish and wildlife. LCRA must also provide public access to, and use of, its lakes and lands for recreation.

In the early years of LCRA's existence, the predominant priorities in water resources management were to moderate and control the floods and droughts in the Lower Colorado River Basin. This was accomplished through the construction of dams in the Texas Hill Country west of Austin, which created the Highland Lakes. Due to the Highland Lakes, the ravages of floodwaters on the lower Colorado River have largely been controlled. The Highland Lakes have historically also provided a dependable source of water supply for municipal, industrial, agricultural, and mining uses. Additionally, the Highland Lakes provided the source of inexpensive, renewable electrical energy, and recreational opportunities for the citizens and communities of Central Texas. In sum, the work of LCRA in its early years provided the foundation on which much of the present day population and economy of Central Texas now depend. The rapidly increasing population of Austin and surrounding Central Texas communities requires additional water resources for drinking water and to sustain business and industry. Tourism and recreation became significant industries, both on the Highland Lakes and lower Colorado River.

The Highland Lakes Region has benefitted from the growth in the Austin Metropolitan area. The Region has maintained much of its Hill Country character and cultural identity but has also exhibited a more independent nature with the development of the extensive Bee Cave and Marble Falls Retail Trade businesses. It has also benefited from the recovery of the lake levels on Lake Travis and Lake Buchanan in 2015, and the draw of highly regarded school districts such as Lake Travis ISD. The combination of strong school systems, attractive retail shopping options and higher lake levels has stimulated strong growth. The Community Impact 2019 Real Estate Edition (Volume 10, Issue 7 on July 10, 2019) reported that "from the southern hills of Travis County up through the inlets and peninsulas of Lake Travis, residential neighborhoods are quickly being developed." A June 2019 report from www.LakeHomes.com, documented the Lake Travis area as the biggest lake market in Texas. They reported that their analysis was based on the combined list prices of its 877 properties for sale. They also reported that the combined list prices total $623,574,159, which not only ranks it the largest lake market in Texas, but the 4th in the country. The Texas school finance system has benefitted significantly from the very large property tax base of the Region. The four largest school districts in the upper Highland Lakes Region—Llano, Marble Falls, Lago Vista, and Lake Travis—have contributed $938.8 million to help balance the State's school finance system. This represents 3.48% of all recapture payments ever received by the State since 1994 to 2019.

Tourism and Recreational Demands

The use of water for recreation and tourism is closely linked to the population of an area, location of the recreational opportunity and ease of access, and the value of the resource to recreational users. Recreational users are interested in qualities such as accessible lakes, flowing rivers, clean water, and aesthetics. In many areas, recreational uses of the waterways are increasing steadily. The entire Highland Lakes area, from Lake Austin to Lake Buchanan, receives a great deal of recreational use from boaters, park visitors, swimmers and anglers from all over Texas and the Southwestern United States.

Recreation and tourism in the Highland Lakes area are important contributors to local economies. The recreation industry associated with the Highland Lakes experienced phenomenal growth from 2000-2010 and became the major economic stability factor in many of the counties surrounding the Highland Lakes. However, the viability of this recreational industry is strongly tied to the level of water in the reservoirs, and LCRA's 1989 Water Management Plan recommended maintaining the water elevation of Lake Travis at 660 feet or more above mean sea level (msl) and of Lake Buchanan at 1,012 feet or more above msl. In the pass through lakes—Inks, LBJ, Marble Falls, and Austin—little direct impact is felt from variations in the levels of Lakes Buchanan and Travis. However, very low lake levels in Lakes Buchanan and Travis appear to divert those recreational users toward the pass-through lakes, which may then experience the over-crowding that was observed in the 2011-2015 period.

Typically, the annual hydrologic cycle includes filling the water supply reservoirs in the winter and spring and drawing down the water levels as water is used during the hot summer months. The recreational users of these reservoirs are accustomed to a certain amount of variation in the lake levels. However, extremely low, sustained lake levels, such as those that occurred from 2011-2015, have had a significant adverse impact on recreational and tourism interests.

To update Appendix 1B, economic data from 2010 to 2018 was collected to assess the most recent growth and development of the Region. In addition, work was done to capture specific impacts of the new drought of record (2008 – 2015) and associated sustained low lake levels on Lake Travis from 2011-2015, as well as the higher lake levels observed from 2015-2018. The data has been collected from many sources, as shown in the list of references and sources. Tourism data on visitation to the Hill Country was provided by Travel Texas from the Economic Development and Tourism Department in the Office of the Governor. Leisure travel to the Hill Country Region, excluding Austin, was growing at a rate of 10% from 2010-2011 (slightly above Austin's rate of 9%). In contrast, leisure travel to the Hill Country grew at an annual average rate of only 2% from 2011-2017 (when Austin travel was increasing at a 7% rate). In 2018, with lakes at high levels, leisure travel visitation to the Hill Country increased to an 8% growth rate.

Lake Travis in Travis County

Lake Travis is a 19,000-acre lake with over 270 miles of shoreline located within Travis and Burnet Counties. Formed in 1937 with the creation of the Marshall Ford Dam, Lake Travis has been and

continues to be an important force in the economic growth and sustainability of the region. Lake Travis is the source of water and electricity for its surrounding communities, including, but not limited to, the municipalities of Briarcliff, Lakeway, Lago Vista, Jonestown, Point Venture, The Hills of Lakeway, Volente, and Austin (currently 23 municipalities rely on Lake Travis for water). The lake is a recreational destination for boaters and other water enthusiasts throughout the state, and it is an important component of the region's tourism economy. Businesses of all sizes depend upon Lake Travis for their operations, including restaurants; hotels; boat sales, rentals and services; marinas; golf courses; scuba operators; and real estate brokers and developers. As customers of retail water suppliers, companies, including Samsung, NXP Semiconductors, AMD, and 3M, rely upon Lake Travis for their manufacturing operations. Finally, the lake is an amenity to the surrounding households. From 1990 to 2010, the size of the population living within 30 miles of Lake Travis more than doubled to over 1.5 million people according to the U.S. Census. According to a new estimate from the Texas Demographic Center, this 30-mile range number grew to 1.9 million in 2017.

Incorporated communities, such as Lakeway, Lago Vista, Jonestown, Point Venture, Briarcliff, and Village of the Hills, were founded around Lake Travis in the 1960s, and Bee Cave has also dramatically developed, with both major retail and residential areas, since 2000. According to the Texas Demographic Center, these incorporated communities have grown by 32% since 2010 to a total population of almost 37,000 as of July 2018, with the largest gains coming in Lakeway and Bee Cave. And, it also should be noted that these population estimates do not include the unincorporated areas, such as Spicewood, which is also rapidly developing, some of which is enabled by technology and business policies that allow employees to work from home and avoid long commute times into the Austin area.

Lake Travis is a controlled-flow lake, with water coming in through rainfall and inflows from area creeks, rivers, and streams, and water going out to serve the demand of surrounding cities, water utilities, irrigation needs for the downstream industrial and agricultural users, and flows sufficient to maintain downstream instream flow needs and bay and estuary health. The lake is considered full at an elevation of 681.1 feet ("full pool") above mean sea level (msl), and lake levels have fluctuated from a low of 614 feet in 1951 to a high of 710 feet in 1991. In addition to its use for flood control, hydroelectric power, water supply, and water quality, Lake Travis supports broad recreational tourism and diverse fish and wildlife habitats. Drought, increased water use, releases to meet downstream demands, and reduced inflows all cause water levels in Lake Travis to fall. Conversely, during flood events, businesses surrounding the lake may be forced to close for extended periods of time, and/or incur significant maintenance costs.

An economic impact study by consulting firm Robert Charles Lesser & Co (RCLCO) in 2011 used historical data and econometric models to assess the financial impact that low lake levels or poor water quality have on the region. This study established a baseline to measure the fiscal and economic impacts associated with Lake Travis in 2010 and found that a sufficiently operational Lake Travis generates revenues from property, sales, hotel and mixed beverage taxes that buys ambulances, maintains schools and provides state government with needed funding. The sources cited in the 2011 study and some new sources, such as the State Comptroller's Office, Texas Parks and Wildlife Department, Travis County Parks, LCRA, Travis County Tax Appraisal District

(TCAD), Travis County, the Texas Demographic Center, and specific lake-related businesses, have been used to expand and update the economic data through 2018.

Key findings describing the status of the Lake Travis economic engine in 2010, with comparisons to the drought period between 2011–2014 and to its status in 2018, are presented below:

- In 2010, $158.4 million in revenue was generated for state and local governments from property taxes. In 2018, the contribution from property taxes grew to over $350 million, based on information received from TCAD on 2018 assessed values in the study area.
- In 2010, 3900 commercial businesses in the Lake Travis area generated $45.2 million in state revenue from sales taxes. In 2018, sales taxes revenue grew to $77.9 million., as shown below:

  Sales Tax Information from Incorporated Communities in Travis County Around Lake Travis from the Texas Comptroller's Office:

		Annual Average		
	2010	2011-2014	2015-2017	2018
State & Local Sales Taxes, $ million	$45.2	$54.8	$69.1	$77.9

- In 2010, $3.4 million in state revenue was generated from hotel and mixed beverage taxes. In 2018, the contributions from Hotel and mixed beverage taxes grew to $7.2 million, as shown below:

  Hotel and Mixed Beverage Taxable Receipts from Incorporated Communities in Travis County Around Lake Travis provided by Texas Comptroller's Office

		Annual Average		
Hotel & Mixed Beverages, $ million	2010	2011-2014	2015-2017	2018
Taxable Receipts	$24.3	28.4	$43.0	$51.3
Taxes Collected	$3.4	$4.0	$6.0	$7.2

- In 2010, $8.4 billion in residential market property value ($2.428 billion in waterfront and total of $4.353 billion in lake-related homes and land property value in 2010 from Travis County Appraisal District (TCAD)); In 2018, $12.771 billion in residential and $1.635 billion in commercial market value was provided by TCAD. In 2019, $3.275 billion in waterfront and total of $5.992 billion in lake-related homes and land property value from TCAD

- Lake related activity in 2010 base case:
  - Total visitor-related spending creates 1,607 jobs, $34.6 million in direct wages, and $90.5 million in value added to the local economy. The data gathered in 2019 for this updated Appendix 1B is consistent with the predictions made in the 2010 study – visitor-related spending creates jobs and provides significant economic benefits to the local economy.

The 2011 Lake Travis Economic Impact Report by RCLCO identified four categories of visitor spending: park visitors, vacation renters, second home owners and boaters. In 2019, comparable data was obtained for park visitors and boating. Regarding park visitors, the 2011 RCLCO Study estimated that park visitors accounted for $38 million in total spending in 2010, based on about 475,000 visitor-days. To update that data, Travis County and LCRA provided park visitation and associated revenue data for 2010-2018 for the lake-related parks that they manage. Combined visitation results in 2014 were about 51% lower than park visits in 2010. With the recovery of Lake Travis water levels in 2015, park visitations have increased every year from the 2014 lows at both the Travis County-managed and LCRA-managed parks, and both Travis County and LCRA reported that visitations slightly exceeded 2010 levels by 2017. Using the daily spending estimates for 2018 found in the 2018 Hill Country Region report provides an estimate of $44.3 million in park visitor spending for 2018 and supports 294 jobs and provides $15.9 million in non-inflation adjusted total value add, the majority of which is labor income**.**

Regarding boating, the 2011 RCLCO Study estimated that boater spending supports an additional 574 jobs, and boat sales support 309 jobs, many of which are related to the commercial and community marinas and private docks on Lake Travis. According to LCRA data, there are now about 120 commercial and community marinas on the Highland Lakes that provide roughly 7,000 boat slips. According to the RCLCO Study, there are also over 2000 dry slips and 30 boat ramps at marinas. According to the LCRA website, there are also 12 public boat ramps on Lake Travis, but only 6 are operational below 660 feet msl, 3 below 650 feet and 1 below 640 feet at Mansfield Dam (closes at 633 feet). As such, there was very limited access from public boat ramps in the 2011-2015 period of very low lake levels. Regarding private boat dock slips, RCLCO determined using aerial images that there were 2,165 private docks on Lake Travis in 2010, many of which were grounded during the low lake level period from 2011-2015, and the boats were moved to storage.

Boat sales supported an additional 309 jobs and an additional $22.1 million in total value add to the economy in 2010$. In 2010, $40.6 million in sales revenue was generated from new and used boat sales in Travis County, according to data from the Texas Parks and Wildlife Department. In 2018, the sales revenue from new and used boat sales has grown to $71.8 million, and has now returned to its previous peak in 2007, as shown below:

Boat Sales in Travis County from Texas Parks and Wildlife Department (TPWD):

			Annual Average		
	2007	2010	2011-2014	2015-2017	2018
Aggregate Sales Value, $M New and Used Boats	$71.0	$40.6	$41.0	$63.5	$71.8

Given the recovery and gains of the boating business, the 2010 RCLCO jobs estimate should at least support their 309 jobs estimate when lake levels are at reasonable operating levels above 660 feet.

Lake levels finally recovered in 2015 and have remained at higher levels, with the exception of a six-month period in 2017, where a "flash drought" and associated very low inflows, which fell to only 2% of average in July 2018, and caused the Lake Travis lake level to fall below 660 feet to about 654 feet. However, heavy rains in October brought Lake Travis levels back up to above- full, and levels have remained at good operating levels above 660 through 2019.

The 2011 RCLCO Study also found that vacation renters support 309 jobs; and second homeowners support 431 jobs. The proportion of second homes on Lake Travis remains very high at approximately 50% in 2018, based on the percentage of homes that are not designated as homesteads. As such, the 2011 RCLCO Study estimate that total visitor spending supports 1609 jobs that provides $90.5 million in value add to the economy (2010$) is viewed to be a valid estimate, and it is likely much higher.

The 2010 RCLCO Study found that adverse economic impacts begin when lake levels remain below 660 feet, and significant economic impacts occur when lake levels fall below 650 feet. Some specific effects that the 2011 Study predicted, with actual results on park visits from the 2019 update, include:

- Fewer park visits - Park visits fell from 475,800 in 2010 to 232,400 in 2014, or about 51% lower.
- 29 lost jobs for each 10% drop in park visits. The 51% reduction in park visits between 2010 and 2014 translates into 145 lost jobs, with a loss of $7.9 million (2010$) in total employment value, per the 2011 RCLCO Study
- $23.6 million to $38.8 million reductions in visitor spending; and
- Up to 241 lost jobs and $6.1 million in lost wages.

The study also found significant annual fiscal impacts could occur, including:

- $21.9 million in total fiscal revenues lost versus the 2010 base case; and
- $1.7 million lost sales tax revenues.

As a result of the extended severe drought that began in 2008 and large interruptible water releases under the governing LCRA Water Management Plan during the severe drought in 2011, Lake Travis lake levels fell to the 620-630 foot elevation and remained there from 2011 until May of 2015. Public access to Lake Travis was severely impaired below 630 feet, and the lake also became much more dangerous to navigate as the lake levels fell. As a result, many of the predicted impacts became reality.

In order to get a better picture of the scope of the adverse economic impacts, information from several directly affected business groups was obtained and compiled in 2019. Boat sales provide a strong indicator for desired utilization of the lakes. Boat sales data for 2006-2018 was obtained from TPWD. It was found that actual numbers of new boat sales in Travis County declined about 15%, and used boats sales numbers fell about 22%, from 2010 to 2014 during the low-lake level period.

Another large key boating-related business group is the commercial marina business. A

questionnaire/survey was conducted in 2019 of the Marina Association of Lake Travis (MALT). Responses were received from many of the major commercial marinas on Lake Travis, and those responses represented about 51% of the total boat slips in the large commercial marinas. The response rate was utilized to scale up the business and employment data provided by the Questionnaire to yield the following current total Lake Travis Commercial Marina business estimates for 2018:

- Annual 2018 revenues of large major marinas alone are estimated to be about $36.4 million/year, with much more revenues provided by rest of the active marinas;
- Annual employee payroll estimated to be about $7 million/year for about 375 full-time, part-time and seasonal employees. It should be noted that there are also many other employees associated with related boat services, restaurant and rental activities at the marinas or other supporting businesses and locations that are not included in these estimates.

Feedback was also requested in the Commercial Marina Questionnaire on the adverse economic impacts that actually resulted from the very low lake levels during 2011-2015, and the recovery once levels returned to higher operating levels in 2015. Specific results from that Survey include:

- Almost all commercial marinas experienced significant reductions in occupancy rates, and associated revenues, during the low lake level years, with several falling to 78% and a few reporting rates as in the 40-60% range. On average, the reduced occupancy rates translated to an annual revenue reduction of about 30% (down about $11 million) versus current performance, with some reporting a revenue reduction approaching 40%.
- Almost all report significant negative financial impacts, such as high dock relocation costs, when the Lake Travis lake level falls below the 640-650 foot msl range, and the impacts worsen if the lake continues to drop
- Numerous marinas reported that the large boats are important for their financial health, and they have been harder to get since the low lake-level period. 2019 appears to be the 1st year that has experienced a significant return of the “big boats” from other cities, such as Houston.

With the return of higher water levels on Lake Travis from June 2015 to the present, results from the Survey show that the average occupancy rates improved back up to 94% in 2018, which is 4% above the 90% occupancy rates reported by the RCLCO Study. In addition, almost all of the responding large commercial marinas report that they are finally realizing higher slip rates than in 2011.

Regarding adverse impacts on other significant lake-related businesses during the 2011-2015 period, with loss of access, tourism greatly declined, and many lake-related businesses and restaurants closed. This included iconic, high-profile ones, such as Carlos’ N Charlie’s that had been in business for many years. In the specific case of Carlos’ N Charlie’s alone, at least 120 employees lost their jobs between 2011- 2014, which represented over $1 million in lost payroll, and. total associated State taxes of over $400k per year were also lost. Another 100

employees lost their jobs in 2015 when it closed in 2015. Just for Fun, a boat rental business, lost an average number of 29 employees from 2010 to 2014, representing over $500,000 in annual payroll. Other support-related businesses, such as boat service businesses also closed, such as Full-Throttle Marine in Spicewood. Other restaurants such as Café Blue in Volente also closed, and many others changed hands. As such, job losses were likely much higher than estimated by the RCLCO Study. However, the largest reduction in boating spending was likely in the daily boat usage category, where a 50% reduction in visitors would likely have a proportional impact. As such, annual spending for daily boat usage could have dropped in the $20 million range by 2014, versus the $40.1 spending level, as estimated by the RCLCO Study in 2010.

Real Estate Impacts from Austin Board of Realty (ABOR) and TCAD

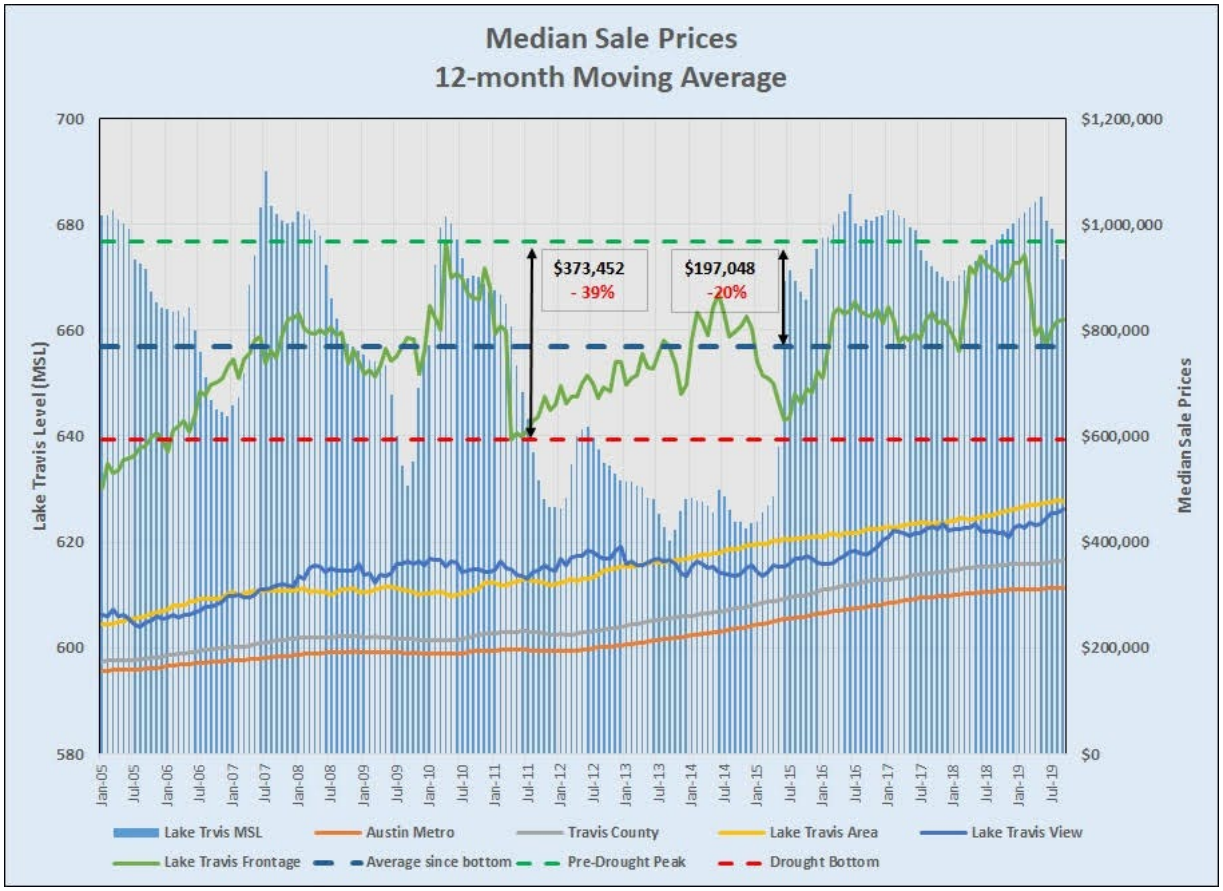
Low lake levels also impacted the real estate sector of the economy during 2011-2015. While the Austin metropolitan area continued to enjoy significant growth and increased property values, lake-related property values greatly suffered, both with homes and unimproved land values. The following results were compiled by the real estate industry for the 2009-2014 timeframe:

- Median sales price decline of waterfront/view homes down 29.5% since 2011
- $/sq. ft. average price decline 33.9% since 2009
- Median undeveloped waterfront/view land price down 36.8% since 2009
- Real estate inventory levels are a very strong indicator of the health of a real estate market. While the residential market across the 5-county Austin metropolitan area had less than three months' supply as of December 2014, active listing inventory for homes with Lake Travis frontage will last more than two years at the Dec. 2014 pace of sales. There was more than three years of listing inventory for unimproved lots on Lake Travis.

These declines in water-related home and land values have a significant aggregate effect, both on the homeowners and on the taxing districts that rely on property taxes. This rapid decline in waterfront market values represented a major reversal from a very strong appreciation history in median sales prices. According to the Austin Board of Realtors (ABOR) real estate data, the median moving average waterfront home rose about 65% from $585k in January 2005 to $966k in April 2010. In an ideal case where Lake Travis levels were stable above 660 feet, waterfront properties should have appreciated at least as well as the 5-county metro area, in general. Median sales prices in the 5-county Metro have appreciated by 65 % from 2010 to 2019. **As such, median prices of waterfront properties should have increased to about $1.598 million per property, if they had enjoyed the same 5-county Metro rate of increase, in a "stable lake" environment.**

It should be noted that the recession that followed severe disruptions in the mortgage and residential real estate industries began (in Central Texas) in mid-2007, reached it's low-point in early 2009, and hovered near that level until early 2011. Residential listing inventories began to decline in mid-2011 and continued to fall as sales increased from then until early 2013, when the now seven-year old boom was fully in place. Residential sale prices in most of Central Texas were much more modestly affected than other parts of the U.S., and aggregate prices in the 5-county Austin metropolitan area were largely unaffected. Median prices of lakefront homes on Lake Travis, however, plummeted 39% between April 2010 and May 2011, almost exactly in parallel with falling water levels (from

681 feet to 653 feet) during the same thirteen months. (See exhibit below.) Prices recovered somewhat between then and mid-2014, but sagged twice more as water levels dipped again in 2013 and 2015, while the rest of the metro area proceeded with unprecedented price increases. In June 2018 and February 2019, lakefront prices almost rose again to April 2010 levels, but fell again and were again 20% lower than that peak by September 2019. This market behavior was clearly not unrelated to the broader recession, but and was highly correlated with changes in Lake Travis water levels and subsequent lack of confidence in sustained water levels and property values.



More specifically, the waterfront property market median prices began a rapid decline in September 2010, and closely tracked the rate of decline in Lake Travis levels, $370k in median pricing down to about $600k, while the 5-county metro area continued its steady growth. During the 2011-2015 period, waterfront median sales prices recovered somewhat until mid-2014, but then fell back to about $630k in mid-2015. With the recovery to higher lake levels in 2015, median home prices climbed to above $900k in early 2018 but have since dropped back to the $820k range in September 2019 due to uncertainty in lake levels.

As such, o**ver the entire 2010-2019 period, average median waterfront home pricing of $780k is down about 19% from the 2010 peak of $966k. However, if we compare the current average**

median price of $820k to the predicted stable lake value estimate of $1.598 million, the predicted waterfront price of $1.598 million is 95% higher per property.

According to data provided by the Travis County Appraisal District, total waterfront market values on Lake Travis were about $2.428 billion in 2010. Their appraised market values were reduced by about $50 million by 2012 and were at $2.574 billion in 2015. With the recovery to higher lake levels, TCAD has increased its total appraised waterfront market values (homes and lots) by 27% from 2015 to $3.275 billion in 2019, which is now up 35% from 2010. An analysis of waterfront data provided by TCAD shows that the average market value for a waterfront home is up to $808k in 2018, which is ow roughly in line with the current real estate market average median pricing.

Applying the current TCAD market value of $808k per home across only the roughly 3000 waterfront homes yields a total of $2.4 billion in market value. **If the values of these waterfront home were actually in line with the predicted "stable lake" median sales value of $1.6 million in 2018, the total waterfront market value would be $4.8 billion, or about double the current market value. Assuming an average 2% property tax rate, this would translate into $48 million of additional tax revenue in 2018, which supports schools and county services. It should be noted that this analysis does not consider the additional value that would also come from waterfront lots ($513 million in 2018) or the waterfront-related home and property values ($2.642 billion in 2018 from TCAD data)**

Looking backwards and assuming that TCAD assessed market values were aligned with the average real estate market, it is possible to estimate the loss of potential property tax revenue that has already occurred from 2010 to 2018. An analysis of real estate average median prices over the 2010 to 2018 period shows a reduction in median market value of waterfront homes of $186k since 2010. **On roughly 3,000 waterfront homes (not including almost 1,500 waterfront lots and 8,800 water-related homes and properties), this represents $558 million in lost market value or about $11.1 million per year in lost property taxes on residential waterfront homes alone. Over the 8-year period between 2010 and 2019, this represent a total impact of about $89 million in lost property tax revenues.** Given the very strong and on-going population growth in the area, and the magnitude of the lost tax revenues from lake-related properties, the shortfalls will likely have to be borne by the rest of the taxpayers to meet required service needs.

Lake Buchanan in Burnet and Llano Counties

Located along the Colorado River, both Burnet and Llano counties have strong agricultural and ranching sectors combined with tourists seeking water-related recreational opportunities on Lakes Buchanan, Inks, LBJ and Marble Falls. Historically, the tourism sector has been the largest employer in the region with visitors spending millions of dollars each year at hotels and resorts, restaurants, and shops. The area has also become popular for retirement and 2nd homes, and the properties around the lakes are among the most valuable in the area. More recently, substantial retail and medical facilities have been built in the area, particularly in the Marble Falls area.

When the drought began in 2008, the reservoir Lake Buchanan fell and remained primarily at levels below the conservation level of 1,012 feet msl. The situation worsened significantly in the summer of 2011, when lake levels fell below 995 feet and continued to fall. At these low levels, lake access was very restricted and public boat ramps were closed, and tourism around the lake was adversely impacted.

In 2011, in a joint effort to measure the contribution of the upper Highland Lakes to the regional and state economies, Burnet and Llano Counties retained a project team to perform an economic impact analysis. The project team of TXP, Inc., Concept Development and Planning, LLC, and Diverse Planning and Development conducted the baseline assessment for Burnet and Llano Counties that was completed in the fall of 2012. The study area for the project included Burnet and Llano Counties as well as the properties at nearby Lake Buchanan, Inks Lake, Lake LBJ, Lake Marble Falls, and Lake Travis (only the portion in Burnet County). The sources cited in the 2011 study, and other new sources, such as the State Comptroller's Office, Texas Parks and Recreation Department, and the Burnet and Llano County Tax Appraisal Offices have been utilized to expand and update the economic data through the 2018/2019 period.

Economic Activity & Tax Revenue Attributable to the Upper Highland Lakes from the 2012 Study

Some of the key findings from the 2012 baseline study that show the scope and importance of tourism and recreation is provided below. Data has been compiled in 2019 to show the growth and development of the Region and identify impacts of the most recent drought of record and associated sustained low lake levels on Lake Buchanan and the Upper Highland Lakes Region. This updated information is also presented below, including information sources.

In 2011, direct spending by all visitors to Burnet and Llano Counties resulted in the following:

- $161.3 million in direct economic activity;
- $58.9 million in earnings for employees and business owners;
- 3,125 jobs (or 25.9 percent of total regional employment);
- $3.46 million in local tax revenue excluding property taxes; and
- $9.2 million in state tax revenue.

Direct spending data from visitors during the 2012-2018 period was not available for the 2019 update. Total Sales Tax information is shown below:

Total Sales Tax Information from Incorporated Communities in Upper Highland Lakes from the Texas Comptroller's Office (from the 2019 update**):**

		Annual Average		
	2010	2011-2014	2015-2017	2018
State & Local Sales Taxes, $M	$25.7	$29.4	$36.3	$41.7

A review of the detailed city/municipality data reveals that the sales taxes generated in the major cities, such as Marble Falls and Horseshoe Bay, remained relatively flat in 2011 and 2012. A large share of the State and Local Sales Taxes were found to be from Marble Falls, which has developed a large retail trade presence and added several new hotels near Lake Marble Falls. Significant contributions from 2015 to 2018 were also made by Horseshoe Bay via its major resort, golf, and recreational boating facilities.

Hotel Occupancy and Mixed Beverage Taxes:

Hotel occupancy tax revenue generated by properties in the Upper Highland Lakes Region more than doubled from 2000 to 2010. In 2012, over 81.1 percent of Burnet and Llano Counties' accommodation and lodging businesses were found to be within two miles of the lakes. As such, the proportion of taxable hotel room revenue attributable to lake-related hotel properties was approximately 75 percent of total Upper Highland Lakes Region hotel sector activity. Lake-related hotel activity generated about $1 million in tax revenues for the State of Texas each year.

In 2011, direct purchases (based on room capacity and hotel occupancy tax receipts) by lake-related visitors to Burnet and Llano Counties from the 2012 Study reported the following baseline information:

- $122.5 million in direct economic activity;
- $45.3 million in earnings for employees and businesses owners;
- 2,454 jobs;
- $2.6 million in local tax revenue excluding property taxes; and
- $7.0 million in state tax revenue.

Hotel and Mixed Beverage Taxable Receipts from Just Communities Around the Upper Highland Lakes provided by Texas Comptroller's Office

- In 2010, $2.3 million in state revenue was generated from hotel and mixed beverage taxes. In 2018, the contributions from Hotel and mixed beverage taxes grew to $4.0 million,

		Annual Average		
Hotel & Mixed Beverages, $ million	2010	2011-2014	2015-2017	2018
Taxable Receipts	$27.8	33.1	$43.0	$49.9
Taxes Collected	$2.3	$2.7	$3.5	$4.0

Hotel and Beverage Taxable Receipts provide a good indicator of tourism and recreation. As the Lake Buchanan water levels returned to and remained above the conservation level of 1,012 feet msl in 2015, an average of $43 million in total hotel and mixed beverage taxable receipts were generated annually in the 2015-2017 period, an increase of 30% compared to the 2011-2014 average annual receipts of $33.1 million. After nearly 3 1/2 years of higher lake levels on Lake Buchanan, taxable receipts from hotels and mixed beverages increased at an annual rate of 8% from $46.3 million in 2017 to $49.9 million in 2018.

Indirect Spending from 2012 Study

The total economic impact in 2011 of lake-related visitor spending in the Upper Highland Lakes, including indirect positive effects on support services and businesses, were described as follows:

- $185.5 million in total economic activity;
- $81.7 million in earnings for employees and businesses owners;
- 3,648 jobs.

Population Trends from the Texas Demographic Center at UTSA:

Communities in the Upper Highland Lakes Region include Burnet, Horseshoe Bay, Llano, Marble Falls, Sunrise Beach Village, and Kingsland. These population trends indicate an impact on growth by low lake reservoir lake levels.

	2010	2015	2018
Population Trend	25,457	26.498	28.839
Rate of Growth vs 2010		4%	13% (9% growth increase from 2015 to 2018)

The rural areas also saw significant population growth from 2010 to 2018, based on analysis of new electric service hook-ups provided by PEC and CTEC.

Specific Low Lake Level Impacts Around Lake Buchanan

Numerous tourism-related businesses suffered or closed as a result of the sustained low-lake level period between 2011-2015, such as restaurants, grocery stores and resorts, and associated job losses and business viability issues have been significant. For example, Thunderbird Lodge on Lake Buchanan reports that they historically brought in 6,000 guests annually. It saw its business drop off by 60-65% during the sustained low lake period, with its boat ramp, dock and marina becoming unusable. To avoid bankruptcy, they cut every cost they could and made payroll cuts, but they still were forced to transition to a new partnership structure for funding, and have now almost recovered, with higher lake levels returning in 2015. Hi-Line Lake Resort was not as fortunate and went bankrupt in 2013.

The charter-fishing business on Lake Buchanan has also been significantly affected by the sustained low lake levels. One of the major long-time bass fishing businesses, Ken Milam Guide Service, has seen its scheduled trip count fall by about 60% on average from around 500 in the pre-drought peak years to lows ranging from 177-254 during the 2011-2015 period. They reported that it also took flexibility and creativity to find ways to access the lake to maintain the business and experience for the customers. Unfortunately, many customers have not returned, and the recovery since then has been slow, with annual trip counts ranging from 170-220 since 2015 to the present. The reduction in business has also taken a toll on the number of other full-time professional guides. Over 30 guides were working during the peak

years, with full time professional guides of about 15. That number has dropped by about 67% to a current group of only 5, which makes it more challenging to host large charter outings. Typical trips average 4 people per trip, so a drop from 500 trips to about 200 per year results in a drop of around 1,200 fisherman per year plus any friends or family that may have come for the trips. This loss of high-revenue visitors has translated in losses of cabin rentals, and for other support businesses such as the convenience stores and restaurants. It has also reduced the number of customers who liked the area and chose to have 2nd homes or relocate into the area. Many businesses have changed ownership, and others are looking at alternative types of business models to help recover and remain viable, as tourism slowly improves.

Boat Sales in Burnet and Llano Counties from Texas Parks and Wildlife Department

	Annual Boat Sales				
	2006	2010	2012	2015	2018
Aggregate Sales,					
New and Used Boats, $M	$9.7	$5.6	$5.5	$7.9	$14.5
Number of New & Used	1,091	767	734	858	1,044

Actual numbers of new boat sales in Burnet and Llano counties declined about 3% and used boats sales numbers fell about 5% from 2010 to 2012 during the early low-lake level period on Lake Buchanan. During this period, total sales revenues from new and used boats remained around $5.5 million, lifted by increasing sales prices of new boats, and the benefit of the option to utilize the pass-through lakes (LBJ, Marble Falls and Inks. With the recovery to higher lake levels in Lake Buchanan in 2015, total boat sales value in Burnet and Llano counties have significantly increased every year since 2015 and are up to $14.5 million in 2018. The number of new and used boat sales in 2018 of 1,044 is also nearing the peak of 1,091 from 2006. As such, overall contributions of boat sales to jobs, wages and overall value add to the economy, and at least support the 2011 baseline spending levels from the 2012 Study.

Property & Real Estate Impacts from BCAD and LCAD and Highland Lakes MLS System & Agents

According to the Burnet County Appraisal District (BCAD), Burnet County experienced a 114% increase in appraised market value from 2002 to 2010 to $6.5 billion. During this period, waterfront properties increased about 175% in appraised market values, and represented about 35% of the taxable market value. According to the Llano County Appraisal District (LCAD), their appraised market values was a $5.4 billion in 2010, and assessed values of waterfront-related communities represented 54% of net taxable values.

The 2012 Study reported that “over the past two decades, communities adjacent to the lakes have been the fastest growing in the two-county area. Since 2000, the majority of new homes built in the Upper Highland Lakes Region have been lake-adjacent. Nearly three-quarters of all homes built in the two counties in the past decade were within two miles of the lakes.” That Study also

found that "the average taxable value of a home on the lakes is substantially greater than the countywide averages – ranging from approximately 70 percent higher around Lake Buchanan to more than 3.5 times the average home price in Burnet and Llano Counties around Lake LBJ and Lake Marble Falls." As such, waterfront properties generate significant local property tax revenue to support schools and local government services.

During the 2011-2015 period of sustained very low reservoir-lake levels, total assessed market values continued to increase in Burnet and Llano counties, but at much lower rates. According to BCAD, appraised market values increased by 16% to $7.6 billion. During this period, county-wide waterfront properties, including the pass-through lakes (Inks, LBJ and Marble Falls), increased only 13% to $1.7 billion, and still represented 34% of taxable market value. During this same period, LCAD records show that their assessed total market values increased 13% to $6.1 billion, but county-wide waterfront community-related properties increased by only 7% to $1.9 billion and represented about 49% of net taxable values.

Appraised Property Data from BCAD & LCAD	2002	2010	2015	2018
Burnet County				
Total Market Value, $B	$3.508	$6.529	$7.594	$9.960
Net Taxable Value, $B	$2.1	$4.296	$4.96	$6.411
Waterfront, $B	$0.545	$1.510	$1.700	$2.046
% Taxable Market Value	26%	35%	34%	32%

Llano County	2010	2015	2019
Total Market Value, $B	$5.358	$6.063	$7.430
Net Taxable Value, $B	$3.318	$3.880	$4.965
Waterfront-related, $B	$1.783	$1.917	$2.378
% Taxable Market Value	54%	49%	48%

Looking at the county numbers after the lakes recovered in 2015, according to BCAD, total assessed market values increased by 31% to $9.96 billion from 2015 to 2018 versus 16% from 2010-2015. County-wide waterfront property market assessments went up 20% from 2015 to 2018 versus the 13% increase from 2010-2015. The percentage of waterfront versus taxable value was 32% in 2018. In Llano County, total assessed market values increased by 23% to $7.43 billion from 2015 to 2019 versus 13 % from 2010-2015. County-wide water-related property market assessments went up 24% from 2015 to 2019 versus only the 7% increase from 2010-2015. The percentage of waterfront-related vs Net Taxable value remained very high at 48% in 2018.

However, when focusing on the assessed values of waterfront-related properties on the reservoir lakes during the period of very low lake levels from 2011-2015, a much different picture emerges, particularly on Lake Buchanan. **Analysis of BCAD waterfront property data on Lake Buchanan shows that total existing assessed property values were reduced from 2010 to 2015 by $41.6 million (19%) from $220 million to $178 million,** after new construction was considered. And **analysis by LCAD on waterfront community property data on Lake Buchanan shows that**

total existing assessed property values were reduced by $28.1 million (16%) from $171 million to $143 million, without new construction adjustment. As such, **the combined loss in assessed market value for waterfront related properties in both Burnet and Llano counties due to sustained low lake levels on Lake Buchanan was $69.7 million in 2015.**

The Peninsula on Lake Buchanan provides an excellent example of a premier development that has significantly suffered from the sustained low lake levels. It was developed in 2007 as a gated community with underground utilities, surface water treatment plant and a private community marina. It has 83 lots, 67 of which are waterfront, and the initial sales prices of the lots were $275-475k, with 37 lots sold in the 2007-2008 period. However, lot sales fell off dramatically with the sustained low lake level periods of 2009 and 2011-2015. In 2012, the original developer went bankrupt, and the new investor had a "fire sale" with 9 original lots offered and sold at 1/3 the original price. This situation continued in 2013 and 2014 with 2 lots selling at $114k vs $300k and $165 vs $385k. Actual home construction in the development has also been severely affected, as only 3 homes were built from 2007-2009 and zero homes were built from 2009-2016 versus an expected 30-40 homes at a normal 5% per year rate. **This represents a significant loss of potential taxable value, in the $30-50 million range in this community alone, as these are $750k-1 million plus homes.**

Looking at Lake Travis in Burnet County, assessed market values of existing waterfront properties remained essentially flat from 2010 at $108 million to $112 million in 2015. New waterfront-related construction between 2010-2015 accounted $11 million.

Beginning in 2015, with the sustained recovery of the reservoir lakes, appraised market values of waterfront-related properties have significantly increased. BCAD data shows that waterfront properties on Lake Buchanan have increased by over $70 million (38%) in assessed market values to $254 million from their 2015 lows and are now $34 million above their 2010 values. However, according to local real estate agents, this partial recovery in actual sales of the high value waterfront lots at the Peninsula in 2017 has not continued in 2018 and 2019 YTD sales. According to the MLS system, average annual residential sales prices on Lake Buchanan have increased by 36% to about $359k from their 2015 levels. BCAD data on Lake Travis reflects about a $27 million (30%) increase vs the 2015 lows and is now $46 million above 2010. Looking at LCAD data on Lake Buchanan, the assessed market values of waterfront properties in 2019 have recovered by $24.6 million (17%) to $168 million, but they have yet to fully recover to their 2010 market values.

Considering long-term implications of the sustained low lake level around Lake Buchanan, two of the key findings from the 2012 Study were evaluated with local real estate agents, and found to appear to still be valid, as follows:

- **"The Highland Lakes community's overwhelming concern is that overall economic activity in the region will not return to its pre-drought growth rate because of the prolonged low lake levels."** The information and data collected for this update continues to validate this concern.
- **Low lake levels could adversely impact development of 5,799 undeveloped, lake-related acres, with an additional 1,180 underdeveloped acres that have a potential taxable**

property value of $1.4 billion around the lakes. Consultation with local real estate brokers reveals that this continues to be a valid concern, particularly around Lake Buchanan.

Community Summaries:
Community summaries, authored by each community, highlight the nature, strengths and growth of the Highland Lakes Region:

Marble Falls - With a city population of just under 7,000, most people would call Marble Falls a small town—but very few would call it "sleepy." The town feels much bigger due to a primary retail trade area population of more than 70,000 and daily traffic counts in the center of town exceeding 35,000 vehicles per day. In 2018, Marble Falls surpassed $1 billion in gross sales for the first time. In the last 5 years, Marble Falls' primary retail trade area population has grown 6.5%, average household income has increased by 21.3%, and median home value has increased by 21.5%. During the same period, taxable sales activity has increased by 31.5% to more than $466 million. Recent developments include Baylor Scott & White's $100 million regional medical center, a new 110,000-square-foot H-E-B grocery store, and a $20 million operations center for Pedernales Electric Cooperative. The development pipeline includes some exciting retail development, multi-family properties, and a Downtown hotel and conference center, in addition to two new subdivisions with more than 1,200 homes planned. People are beginning to see Marble Falls as more than just a touristy, scenic lake town on the outskirts of the Austin metro area.

Lakeway - Since its inception, the city of Lakeway has been closely tied to the quality water resources found in central Texas. Its name alone demonstrates its tie to Lake Travis as what first attracted visitors to the area and the growth of the city. Within the city limits are several miles of shoreline with a number of businesses directly related to activities on or near Lake Travis. With a population of over 15k people, Lakeway is now the third largest city in Travis County with a growth rate of 5% annually over the last 18 years. The city generates $12 million revenue annually with $1 million coming from the Hotel Occupancy Tax. Property values have tripled between 2006 and 2018; however, there is a clear recognition how the water level and quality of Lake Travis can impact that trend. Much of the city falls in the Lake Travis watershed and there is close coordination with the LCRA to review projects for compliance with the Highlands Lakes Watershed Ordinance. In a recent citizen survey, availability of quality water, proper disposal of wastewater, and protection of the Lake Travis water resource were three of the top ten highest priorities out of over 60 categories covered. Lakeway's bond with quality water resources is a key to its future.

Bee Cave - Just like most other Cities in the region, Bee Cave has experienced a significant amount of growth. The current projected population (8300) is more than double the 2010 (4000) population and 8x higher than the year 2000. Although valuations and property tax revenues have tripled in that time, the City of Bee Cave maintains a $.02/$100 property tax rate and is reliant on sales tax revenues for the general operation of the city. Annual sales tax revenue doubled in the last 10 years, topping $10.5M in FY '18-19 and continues to rise with new investments in the community such as an $850M mixed-use planned development, event venue, multiple hotels, and residential development. Bee Cave's sales tax numbers are driven by the number of people who travel to the city as a destination and through the city to enjoy the other things the local area has to offer. Since 2000, Bee

Cave has become home to over 2.1M sq. ft. in retail shopping space, which acts as a magnet to members of neighboring communities and from adjoining counties. The majority of Bee Cave's retail growth has occurred in an area of the city where 3 major state highways, TX-71, RM-620, and RM-2244 intersect. Texas Highway 71 averages 50,000 trips per week day and Ranch to Market 620 between Bee Cave and Lakeway averages over 47,000 daily trips. Finally, RM 2244 generates over 34,000 vehicular trips per day to and from the greater Austin area. The economic health of the City of Bee Cave is reliant on factors within the city's jurisdiction, but the impact of neighboring jurisdictions, such as our immediate neighbor Lakeway, may be equally important to our community. While not a lake town, Bee Cave is very tied to the other communities in the Lake Travis watershed.

Lago Vista – Nestled in the Hill Country between Cedar Park and Marble Falls, Lago Vista is a Lake Travis community with small town charm. Originally founded as a golf resort community, Lago Vista has experienced substantial population growth in the past several years with a 2019 population estimate of 8,046. Within a 15-minute drive is 12,075 households with a population of 31,843 and a growth rate of 28.80%. Young families are choosing to move to Lago Vista for the excellent schools, low crime rates, and variety of recreation opportunities. Lago Vista also has amenities that include POA-owned lakefront parks, tennis courts, baseball fields and frisbee golf courses. Swimming, camping, boating, kayaking, golf, and hiking trails are also favored activities. The Travis County Arkansas Bend Park in Lago Vista is available to the public. The City of Lago Vista is in the process of completing Phase One of a new municipal sports and recreation complex. Expected completion is May 2020. A variety of sports and entertainment events are held in Lago Vista each year. Lago Fest is a large live music, art, and food festival on the shore of Lake Travis in Bar-K Park. Festival goers enjoy coming by boat as well as land. Lago Fest is held at the same time as the Austin Yacht Club's Annual Turnback Regatta. Sailors race to the shore of Bar-K Park camp overnight and race back in the morning. The highly touted La Primavera bike race is held in Lago Vista offering serious cyclists a challenging course throughout the city's winding hilly roadways overlooking the lake. The Lago Vista business community includes medical facilities, corporate manufacturing, financial advisors, retail shopping, restaurants and service providers. Starbucks just opened and is a new addition to the Lago Vista community.

Lake Buchanan Community - The communities on the banks of Lake Buchanan, including surrounding areas in both Llano and Burnet Counties, continue to grow at a noticeable rate. The area has traditionally been a mecca for retirees looking for a slower pace of life at reduced living costs. That is changing, as the cities of Llano, Kingsland and Burnet have become shopping, supply and dining attractions. Numerous wineries and tasting rooms have opened, as a way to attract visitors seeking smaller crowds than found along the Winery Highway between Johnson City and Fredericksburg. To further capture these tourist dollars, numerous RV, resort and owner short term rentals have successfully opened. In addition to the peak summer traffic from parents transporting children to a variety of camps, the area has become an arts destination, with the oldest art guild in Texas located at Buchanan Dam, and other festivals such as LEAF, twice yearly Llano Studio Tours, Western Art on the Llano, and Paint the Town and Burnet Plein Air Festival, growing in participation and attendance. Fishing continues to fuel the economy on the lake, with Buchanan providing some of the best Striper bass fishing in the world.

Emerging Issues in the Highland Lakes Region:

Water Access Issues for Firefighting in Travis County ESD 8 Service Area at Lake Levels below 650 ft msl - In a 2018 Assessment provided by the ESD 8 Fire Chief – He reports that Travis County Emergency Services District 8 needs Lake Travis for firefighting operations. When Lake Travis reaches 650 feet, available water for firefighting is reduced. Low lake levels also increase the danger to the public by exposing them to underwater hazards as they become more prevalent. ESD 8 provides coverage to 15,000 full-time residents in its approximately 54 square mile service area. At levels above 650 feet, water access for firefighting is provided by 8 Hydrant Areas and 17 Drafting Locations. At 650 feet lake elevation, 5 of the Drafting Locations become questionable. If Lake Travis continues to drop and reaches 640, the Fire Department could be in a critical need for water. The district could be faced with transporting water from only 1 reliable water source location at Briarcliff Marina, and turnaround times could be 30-40 minutes. As an example of the risks when the Lake Travis water level is low, the Labor Day 2011 Pedernales Bend Wildfire burned 6,500 acres, destroyed 70 structures, and left 545 homes without power.

Zebra Mussels – In a 2019 Survey of Lake Travis Marina Owners, almost all marinas reported that Zebra mussels are causing negative impacts. They noted factors such as need for cleaning of dock ladders and hoists; more problems with cable work, motors and inlets on boats, particularly on boats that remain in the water; and safety issues related to minor injuries from sharp surfaces caused by the Zebra mussels.

Sedimentation and Flooding in Upper Highland Lakes – There is a question as to who is responsible for helping communities with flooding and sedimentation issues.

REFERENCE DOCUMENTS, SOURCE MATERIALS, AND INFORMATION CONTRIBUTORS:

- "Lake Travis Economic Impact Report" prepared by Robert Charles Lesser & Co. (RCLCO) for Travis County and the Lake Travis Economic Stakeholders Committee (Sept. 2011);
- "The Economic Impact of the Upper Highland Lakes of the Colorado River" prepared by TXP, Inc., Concept Development & Planning, LLC, and Diverse Planning and Development for Burnet and Llano Counties (Fall 2012);
- County Appraisal Districts - data on property appraised valuations.
    - Travis County Appraisal District
    - Burnet County Appraisal District
    - Llano County Appraisal District
- Multiple Listing Service reports on property sales
- Texas Demographic Center at the University of Texas at San Antonio (UTSA)
- Texas Parks and Wildlife Department (TPWD)
- Marina Association of Lake Travis (MALT)
- Economic Development and Tourism Department; Office of the Governor
- Travis County Parks
- Lower Colorado River Authority (LCRA)
- Upper Highland Lakes Retail Trade Area Demographic Profile prepared by the Retail Coach for the Marble Falls Economic Development Corporation, July 2019
- Marble Falls Economic Development Corporation
- City of Bee Cave
- City of Lakeway
- City of Lago Vista
- Travis County Emergency Services District 8
- Pedernales Electric Cooperative, Inc (PEC)
- Central Texas Electric Cooperative, Inc. (CTEC)
- Various owners of lake-oriented businesses and local community leaders