CHAPTER 1
PLATEAU REGION DESCRIPTION

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1 PLATEAU REGION

Located along the southern boundary of the Texas Edwards Plateau, the six-county Plateau Water Planning Region stretches from the Central Texas Hill Country westward to the Rio Grande (Figure 1-1). Under land grants issued by Mexico and later by the Republic of Texas in the early 1800s, European immigrants (predominantly German) and transient settlers from the southern United States colonized this rugged land formally occupied for centuries by citizens of Mexico and Native Americans. These immigrants and those to follow settled small towns along many of the spring-fed streams that crossed the area and from these way stations spread out to establish farms and ranches throughout the Region. Even today, the area retains much of its original cowboy frontier and German and Hispanic heritage. Chapter 1 that follows is a broad introduction to this Region and the water supply challenges it faces. The Region's economic health and quality of life concerns, including the aquatic environment and recreational opportunities, are dependent on a sustainable water supply that is equitably managed.

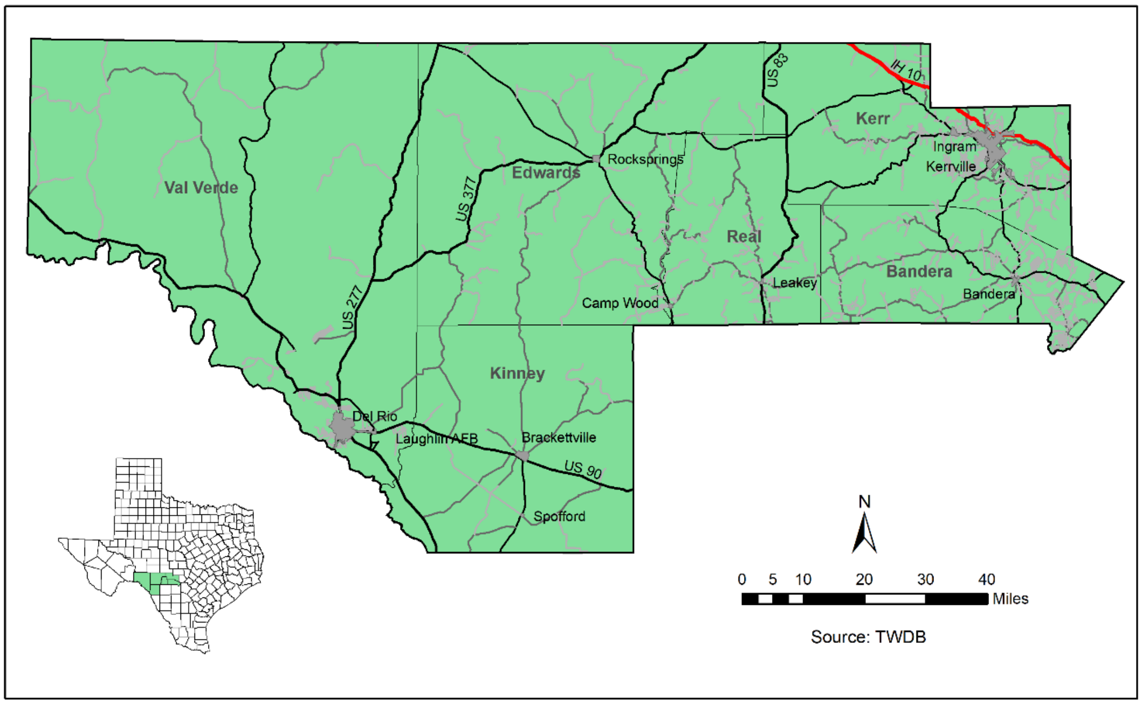

Figure 1-1. Location of the Plateau Region

1.1 WATER PLANNING AND MANAGEMENT

1.1.1 Regional Water Planning

In January of 2021, the fifth round of regional water planning was concluded with the adoption of the *2021 Plateau Region Water Plan*. It is understood that this *Plan* is not a static plan but rather is intended to be revised as conditions change. For this reason, the *Plan* put forth in this document is not a new *Plan*, but rather an evolutionary modification of preceding *Plans (2001, 2006, 2011, 2016 and 2021)*. Only those parts of the previous *2021 Plan* that required updating, and there were many, have been revised.

The purpose of the *2026 Plateau Region Water Plan* is to provide a document that water planners and users can reference for long and short-term water management recommendations. Equally important, this *Plan* serves as an educational tool to enlighten all citizens as to the importance of properly managing and conserving the delicate water resources of this pristine Region. Chapter 1 presents a broad overview of the Region and many of the key issues that must be addressed as part of any attempt to develop a comprehensive water management plan that is acceptable and beneficial to those who reside here.

The PWPG is a voluntary association comprised of voting and non-voting members who represent a minimum of 12 water-use categories. Since 1997, the PWPG has been involved in a wide range of projects, programs and the development of the *Plateau Region Water Plan*.

The *2026 Plateau Region Water Plan* follows an identical format as the plans prepared by the other 15 water planning regions in the State as mandated by the Texas Legislature and overseen by the Texas Water Development Board (TWDB). The *Plan* provides an evaluation of current and future water demands for all water-use categories and evaluates water supplies available during drought-of-record conditions to meet those demands. Where future water demands exceed available supplies, management strategies are considered to meet the potential water shortages. Because our understanding of current and future water demand and supply sources are constantly changing, it is intended for this *Plan* to be revised every five years or sooner if deemed necessary.

During the fifth round of regional water planning, the 2021 Regional Water Plans and 2022 State Water Plan were modified to be aligned with water utility service areas, rather than political boundaries, such as city limits. This was due to TWDB rule revisions, that now define a municipal water-user group (WUG) as being utility based. Some cities that were once included in the 2016 and older regional water plans, that are not represented in the 2021 and 2026 Plans because they do not have their own water and therefore no longer meet the TWDB WUG definition. For these entities, their population is represented through: (1) utility WUGs who provide water for them and meet the new WUG definition, or (2) county-other WUGs as aggregated rural population.

In the development of this *Plan* it was essential to coordinate planning efforts with adjacent regions (Regions E, F, K, L and M) to ensure that there were no conflicting strategies pertaining to shared or transferred water-supply sources. This coordination resulted in there being no known conflicts between this *Plan* and plans prepared for other regions.

Water-supply availability under drought-of-record conditions is considered in the planning process to ensure that water demands can be met under the worst of circumstances. Recommendations of the Drought Preparedness Council are considered in this *Plan*.

For surface water supplies, drought-of-record conditions relate to the quantity of water available to meet existing permits from the Rio Grande, Nueces, Colorado, Guadalupe, and San Antonio rivers and their tributaries as estimated by the Full Authorization Run (Run 3) of the Texas Commission on Environmental Quality (TCEQ) - Water Availability Models (WAM). For this *Plan,* the assessment of surface water availability reflects updates representing new and/or amended water rights along with current operating policies and/or contractual agreements. The *2026 Pan* has no impact on navigation on surface water courses.

The availability of groundwater during drought-of-record conditions is based primarily on Modeled Available Groundwater (MAG) declarations that may be produced on an average annual basis to achieve a Desired Future Condition (DFC) as adopted by Groundwater Management Areas (GMAs) (per Texas Water Code §36.001). Groundwater availability volumes for parts of the Region where MAGs are not determined by the TWDB are calculated separately. The GMA process is described in greater detail in Section 1.1.6 of this chapter. Chapter 3 contains a detailed analysis of water-supply availability in the Region.

This *Plan* continues to benefit from environmental data on the more prominent watercourses in the Region as provided by the Texas Parks & Wildlife Department. This data was useful in the assessment and consideration of environmental flow needs, springs, and ecologically significant stream segments.

This *2026 Plateau Region Water Plan* fully recognizes and protects existing water rights, water contracts, and option agreements. The PWPG strongly encourages all entities to participate in the planning process so that their specific concerns can be recognized and addressed. The PWPG also encourages the participation of Groundwater Conservation Districts and recognizes their management plans and rules.

Water quality is recognized as an important component in this 50-year water plan. Water supplies can be diminished or made more costly for its intended use if water quality is compromised. To ensure that this *Plan* fully considers water quality, the Federal Clean Water Act and the State Clean Rivers Program were reviewed and considered when developing water-supply availability estimates (Chapter 3), water management strategies and water quality impacts (Chapter 5), and policy recommendations (Chapter 8).

Also, considered in the above segments of the *Plan* were the Water Quality Management Plans (WQMPs) of TCEQ and the Texas State Soil and Water Conservation Board (TSSWCB). TCEQ’s WQMP is tied to the State’s water quality assessments that identify and direct planning for implementation measures that control and/or prevent priority water quality problems. Elements contained in the WQMP include effluent limitations of wastewater facilities, total maximum daily loads, nonpoint source management controls, identification of designated management agencies, and groundwater and source water protection planning. TSSWCB’s WQMP is a site-specific plan developed through and approved by Soil and Water Conservation Districts for agricultural or silvicultural lands. The plan includes appropriate land treatment practices, production practices, management measure, and technologies.

In the year 2020, the U.S. Census Bureau performed a census count, which provides the base year for future population projections in the Region. Although the PWPG accepts the 2020 census count, to include the TWDB approved revision requests provided by the water utilities, members express concern that the census does not recognize the significant seasonal population increase that occurs in these counties as the area draws large numbers of hunters and recreational visitors, as well as absentee land owners who maintain vacation, retirement, and hunting homes and cabins. Therefore, an emphasis is being made in this planning document, especially in the rural counties, to recognize a need for more water than is justified simply from the population-derived water demand quantities.

1.1.2 Interim Planning Project Reports

Previous planning periods included interim projects designated by the PWPG to evaluate specific water-supply availability and management issues (Table 1-1). These reports can be accessed on the Upper Guadalupe River Authority website at http://www.ugra.org/plateau-water-planning-group.

Table 1-1. Interim Planning Project Reports

Interim Planning Project Reports	Date
Groundwater Resources of the Edwards Aquifer in the Del Rio Area, Texas	2001
The Lower Trinity Aquifer of Bandera and Kerr Counties, Texas	2001
Springs of Kinney and Val Verde Counties	2005
Spring Flow Contribution to the Headwaters of the Guadalupe River in Western Kerr County, Texas	2005
Installation of Groundwater Monitoring Equipment in Designated Wells in the Plateau Planning Region	2005
Water Rights Analysis and ASR Feasibility in Kerr County	2009
ASR Feasibility in Bandera County	2009
Groundwater Data Acquisition in Edwards, Kinney and Val Verde Counties, Texas	2010
Water Use by Livestock and Game Animals in the Plateau Regional Water Planning Area	2010
Occurrence of Significant River Alluvium Aquifers in the Plateau Region	2010

1.1.3 State Water Plan

The Texas Water Development Board (TWDB) adopted *Water for Texas 2022* as the official State Water Plan of Texas. The Texas Water Code directs the TWDB to periodically update this comprehensive water plan, which is used as a guide to State water policy. The 2022 State Water Plan is the fifth water plan to incorporate water management and policy decisions made at the regional level as expressed in the 16 approved regional water plans.

1.1.4 Local Water Management Plans

The Plateau Region often experiences periods of limited rainfall, especially compared with more humid areas in the eastern part of the State. Although residents of the Region are generally accustomed to these conditions, the low rainfall and accompanying high evaporation underscore the necessity of developing plans to manage resources responsibly and to respond to potential disruptions in the supply of groundwater and surface water caused by drought conditions. The following entities have developed water management and drought contingency plans:

- City of Del Rio
- City of Brackettville
- City of Kerrville
- City of Bandera
- City of Leakey
- City of Camp Wood
- Fort Clark Municipal Utility District

- Aqua Texas
- Headwaters Groundwater Conservation District
- Bandera County River Authority and Groundwater District
- Kinney County Groundwater Conservation District
- Real-Edwards Conservation and Reclamation District

1.1.5 Groundwater Conservation Districts

The Texas Legislature has established a process for local management of groundwater resources through Groundwater Conservation Districts (GCDs), which are charged with managing groundwater by providing for the conservation, preservation, protection, recharging and prevention of waste of groundwater within their jurisdictions. An elected or appointed board governs these districts and establishes rules, programs and activities specifically designed to address local problems and opportunities. Texas Water Code §36.0015 states in part, "Groundwater Conservation Districts created as provided by this chapter are the State's preferred method of groundwater management." Four districts are currently in operation within the Plateau Region (Figure 1-2); their management goals are discussed in further detail in Chapter 6.

- Bandera County River Authority and Groundwater District
- Headwaters Groundwater Conservation District
- Real-Edwards Conservation and Reclamation District
- Kinney County Groundwater Conservation District

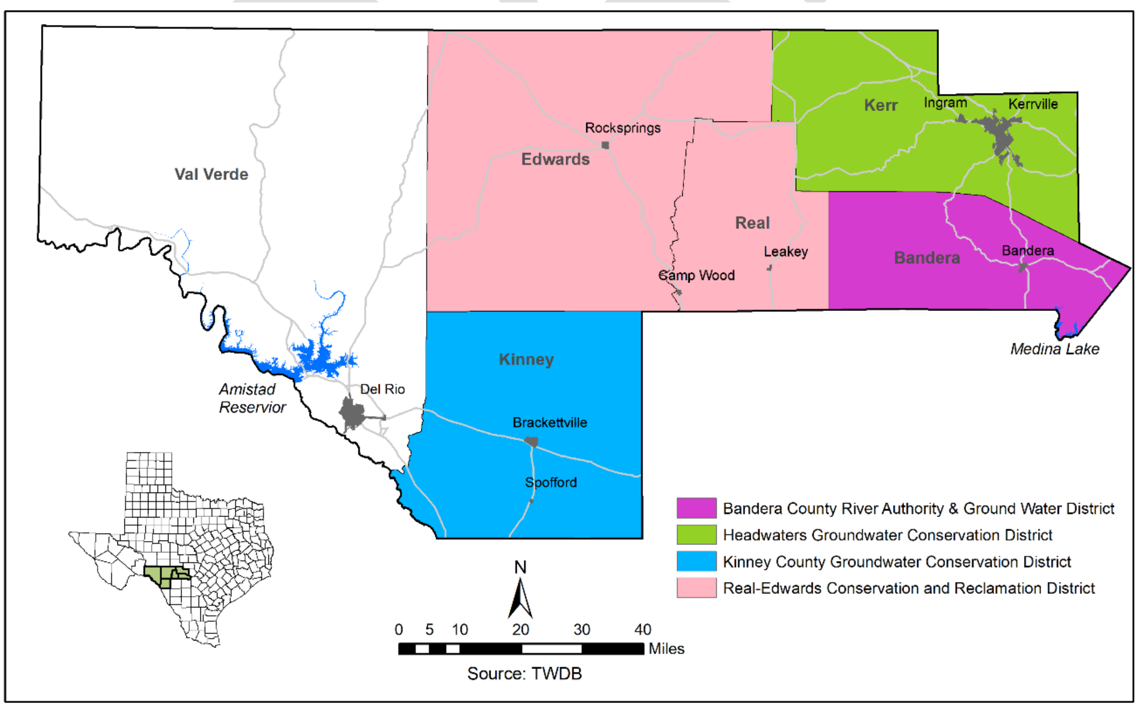

Figure 1-2. Groundwater Conservation Districts

1.1.6 Groundwater Management Areas

In previous sessions, the Texas Legislature has redefined the manner in which groundwater is to be managed (http://www.twdb.texas.gov/groundwater/management_areas/index.asp). Senate Bill 2 of the 77th Texas Legislature (2001) authorized:

- The TWDB to designate Groundwater Management Areas that would include all major and minor aquifers of the State.
- Required Groundwater Conservation Districts to share groundwater plans with other districts in the Groundwater Management Area.
- Allowed a Groundwater Conservation District to call for joint planning among districts in a Groundwater Management Area.

The objective was to delineate areas considered suitable for management of groundwater resources. A Groundwater Management Area (GMA) should ideally coincide with the boundaries of a groundwater reservoir (aquifer) or a subdivision of a groundwater reservoir, but it may also be defined by other factors, including the boundaries of political subdivisions. In December 2002, the TWDB designated 16 GMAs covering the entire State (https://geographic.texas.gov/maps).

In 2005, the Legislature once again changed the direction of groundwater management. The new requirements, codified in Texas Water Code Chapter 36.108, required joint planning in management areas among Groundwater Conservation Districts. The new requirements direct 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."

Desired future conditions (DFCs), as described in Title 31, Part 10, §356.10 (6) of the Texas Administrative Code are "the desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint planning process." This description is a precursor to developing a volumetric number called Modeled Available Groundwater (MAG). The TWDB is responsible for providing each GCD and Regional Water Planning Group (RWPG), located wholly or partly in the management area, with MAG volumes for each specified aquifer. Once the MAG is determined, the districts begin issuing groundwater withdrawal permits to support the DFC of the aquifer up to the total amount of the MAG. These permits express DFCs by only allowing withdrawals that will support the conditions established by the GMA. Regional water plans must also incorporate the MAG for each aquifer within their regions. GMA DFCs are thus recognized as the conservative means of sustainably preserving groundwater supplies for use by future generations. The counties of the Plateau Region are included in three GMAs:

- GMA 7 includes Edwards, Kinney (partial), Real and Val Verde
- GMA 9 includes Bandera and Kerr
- GMA 10 includes Kinney (partial)

DFCs have been adopted for specified aquifers in these GMAs, and, therefore, this *2026 Plateau Region Water Plan* includes a revision to all groundwater source availability estimates based on MAG volumes generated from the GMA process. According to the approved DFCs, MAG volumes within Kerr County associated with the Edwards-Trinity (Plateau) Aquifer, changed significantly for the sixth cycle of regional water planning. Total groundwater availability is the sum of both the MAG and non-MAG volumes for a particular aquifer.

1.1.7 Hill Country Priority Groundwater Management Area

A portion of the Plateau Region (Bandera and Kerr Counties) is included in the initial Hill Country Priority Groundwater Management Area (PGMA). The PGMA process is initiated by the TCEQ, who designates a PGMA when an area is experiencing critical groundwater problems or is expected to do so within 25-years. These problems include shortages of surface water or groundwater, land subsidence resulting from groundwater withdrawal, or contamination of groundwater supplies. Once an area is designated a PGMA, landowners have two years to create a GCD. Otherwise, the TCEQ is required to create a GCD or to recommend that the area be added to an existing district. The TWDB works with the TCEQ to produce a legislative report every two years on the status of PGMAs in the State. The PGMA process is completely independent of the current GMA process and each process has different goals. The goal of the PGMA process is to establish GCDs in these designated areas so that there will be a management entity to address the identified groundwater issues. PGMAs are still relevant if there remain portions within these designated areas without GCDs. The Plateau Region's portion of the Hill Country PGMA (Bandera & Kerr Counties) has established GCDs. A statewide map of the declared PGMA areas is available at: https://www.twdb.texas.gov/waterplanning/rwp/img/pgma_areas.pdf.

1.2 REGIONAL GEOGRAPHIC SETTING

1.2.1 Plateau Region

The Plateau Region encompasses six counties in the west-central part of the State of Texas, stretching from the headwaters of the Guadalupe and San Antonio rivers in the Central Texas Hill Country westward to Del Rio and the Rio Grande international border (Figure 1-1). With a total area of 9,252 square miles (mi^2), the Plateau Region represents 3.5 percent of the total area of the State and includes the counties of Bandera (792 mi^2), Edwards (2,120 mi^2), Kerr (1,106 mi^2), Kinney (1,364 mi^2), Real (700 mi^2), and Val Verde (3,171mi^2).

1.2.2 Physiography

The Plateau Region lies along the southern edge of the Edwards Plateau and is bounded on the east by the Central Texas Hill Country and on the west by the Rio Grande international border. The Balcones escarpment generally forms the southern boundary of the Plateau Region. The escarpment is a steep topographic feature that traces the path of a major fault system that was active more than 10 million years ago. The escarpment separates the more resistant rocks of the Edwards Plateau to the north from softer and more easily erodible rocks to the south. Erosion by streams has cut steep canyons into the thick limestone beds of the Edwards Plateau.

Its rolling prairies, steep canyons, and the large number of spring-fed perennially flowing streams characterize the Region. The uplands are fairly level, but the landscape of the stream valleys is very hilly with steep canyons that provide rapid drainage. Upland soils are dark alkaline clays and clay loams; the river valley soils are gravelly and light colored. Some cultivation takes place in the deep, dark-gray or brown loams and clays of the river bottoms and, over the broad flat farming belt of Kinney County. The major soil management concerns are brush control, low fertility and excess lime.

1.2.3 Population and Regional Economy

The projected year 2030 population in the Plateau Region of 140,468 results in a population density of 15.3 people per square mile, which is much less than the State average of 72 people per square mile. The regional population is projected to grow by 10 percent to 154,530 by 2080. Approximately 50 percent of the total population of the Region is in the two largest cities, Del Rio / Laughlin AFB (37,572) and Kerrville (33,038). The projected year 2030 populations of other major communities in the Region are: Brackettville and Fort Clark Springs (2,449); Bandera (1,949); Rocksprings (666); Camp Wood (339); and Leakey (210) (Figure 1-3). These population estimates do not include a significant transient (tourist, hunting, recreation, etc.) population that has a resulting significant impact on overall water-supply demand in the Region. Current and projected future population of the Region is discussed in detail in Chapter 2.

The Regional economy is based primarily on tourism, hunting, ranching agribusiness and government. The beauty of the Hill Country, the solitude of the forested canyons and plateau grasslands, and the gateway to Mexico all support a major tourist trade. Agribusiness is predominantly associated with the raising of sheep, goats, beef cattle and exotic game throughout the Region. Apple orchards in Bandera County, oil and gas production and mohair production in Edwards and Real Counties, medical services and manufacturing in Kerr County, irrigated cotton, hay and wheat in Kinney County, and a military base and trade with Mexico in Val Verde County all contribute largely to the Region's overall economy.

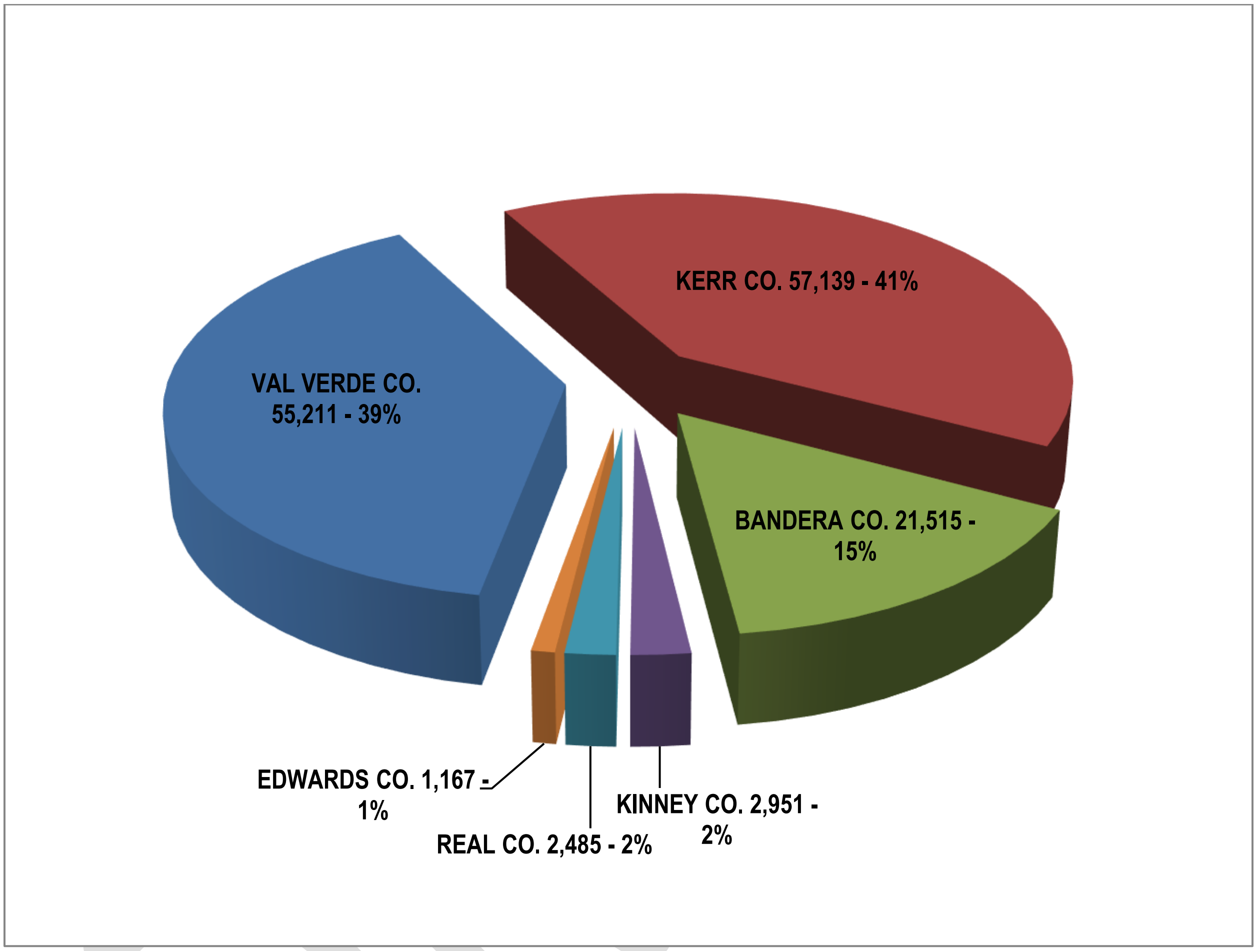

Figure 1-3. Year 2030 Projected Population

1.2.4 Land Use

Land use in the six-county Region is divided into seven categories (Figure 1-4):

- Urban (or developed)
- Agricultural (cultivated)
- Rangeland
- Forest
- Grassland
- Wetlands
- Barren Land
- Shrubland/scrubland

Urban lands are the location of cities and towns that make up less than one percent of the Region's total land area. Agricultural lands are identified as areas that support the cultivation of crops. These lands, which potentially involve extensive irrigation, also occupy less than one percent of the Region. Together, urban and agricultural lands comprise the two most significant areas of water consumption in the Plateau Region.

Rangeland is defined as all areas that are either associated with or are suitable for livestock production. Although this is the largest category of land use in areal extent in the Region, rangeland accounts for one of the smallest sources of water demand. Forestland is limited to areas where topography and climate support the growth of native trees. Grasslands are areas characterized for having vegetation dominated by grasses, usually found in a semi-arid climate. Rainfall and soils are insufficient to support significant tree growth. Areas designated as either water or wetlands are associated with the rivers and their tributaries. Barren lands are defined as undeveloped areas with little potential for use as agricultural land, rangeland or forestland. Shrubland and/or scrubland is a plant community characterized by vegetation dominated by shrubs, often also including grasses, herbs, and geophytes.

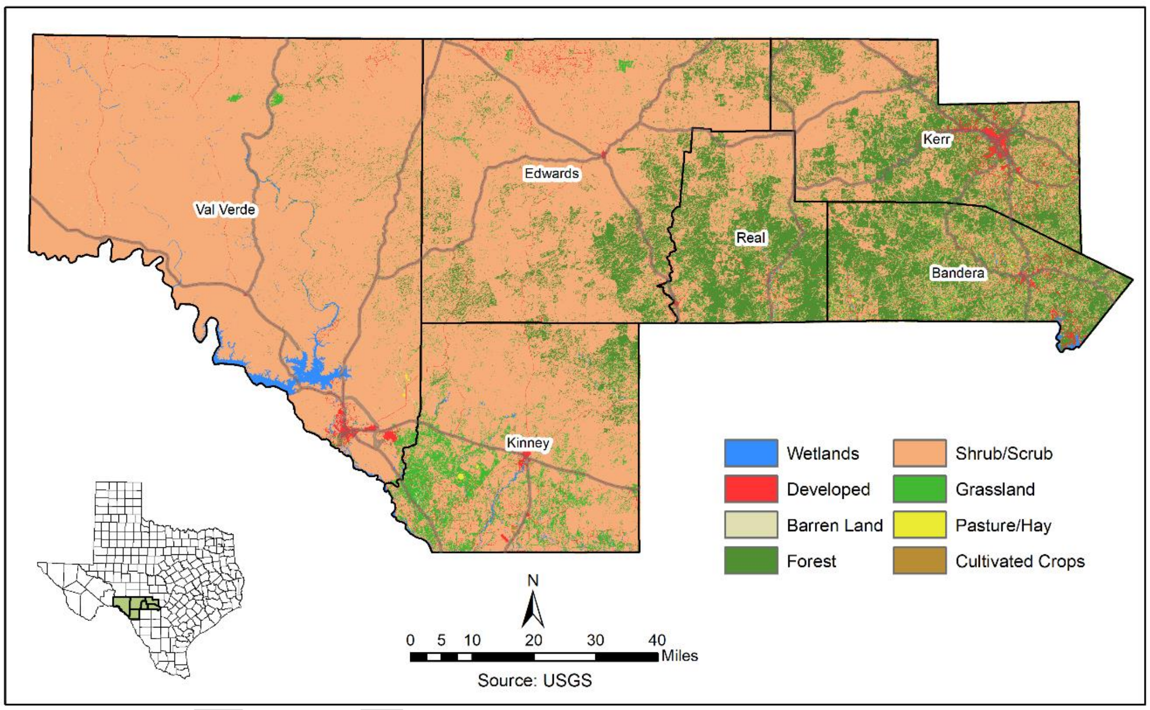

Figure 1-4. Land Use

1.2.5 Climate and Drought

The climate of the Plateau Region is semi-arid to arid as precipitation decreases westward across the Region. The average precipitation for the Edwards Plateau is 25 inches. Figure 1-5 illustrates the variability with respect to the six counties of the Region with precipitation decreasing from approximately 35 inches in the easternmost reaches of Bandera and Kerr Counties to less than 17 inches in western Val Verde County (National Weather Service). Net lake evaporation (Figure 1-6) increases from 58 inches in Bandera and Kerr Counties to about 78 inches in western Val Verde County (TWDB). Net lake evaporation is the difference between total evaporation from a lake and total precipitation. Figure 1-7 illustrates average monthly rainfall recorded at selected stations.

Long periods of below normal rainfall may have severe impacts on groundwater recharge, spring flow, and stream flow. Under these conditions, the lack of rainfall leads to reduced recharge to aquifers and to lower water levels in wells. As water levels fall in aquifers in drought-stricken areas, the volume of water discharging from important water supply related springs may diminish to the point that communities reliant on spring water, such as Camp Wood in Real County, may experience an insufficient water supply to meet their full needs. Landowners who are dependent on spring-fed stream flow may also find insufficient volumes of surface water needed to support irrigation or other farming and ranching activities. The direct linkage between precipitation and water levels in aquifers of the Plateau Region is indicated by hydrograph records of wells that show rapid rises in water levels as a response to local rainstorms.

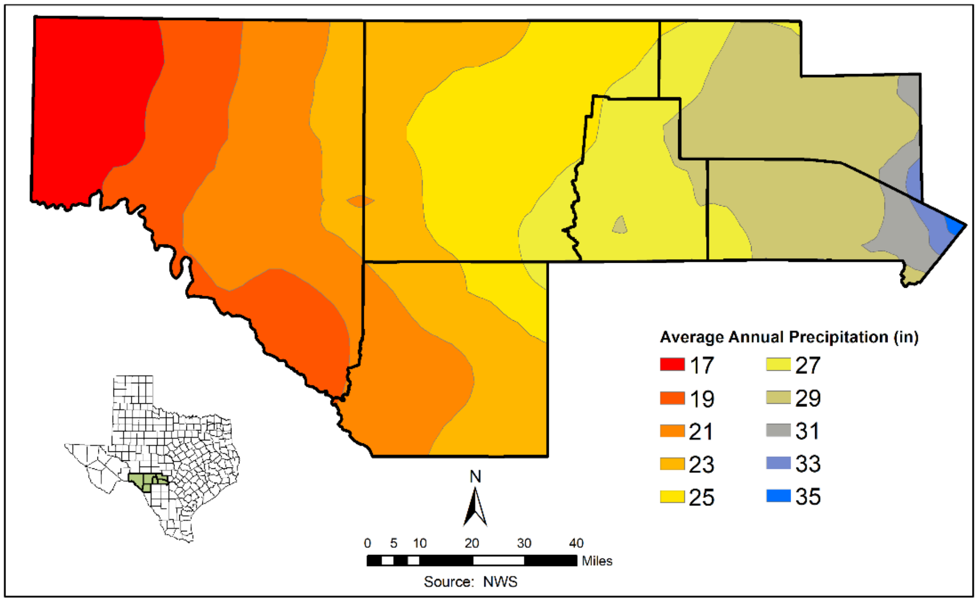

Figure 1-5. Variation of Precipitation

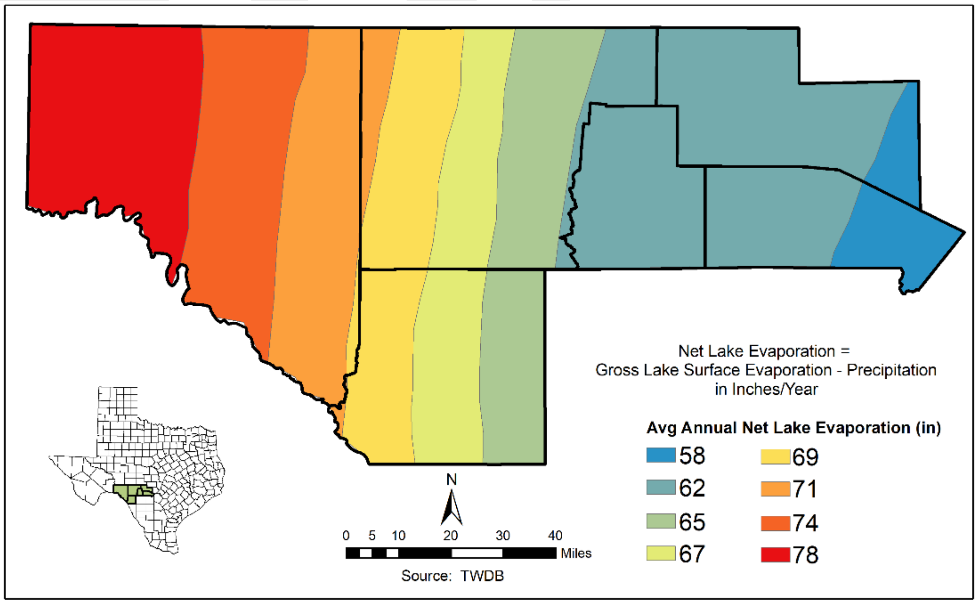

Figure 1-6. Net Lake Evaporation

Past climatic precipitation data was collected from the National Oceanic and Atmospheric Administration (NOAA), for the purposes of calculating average monthly rainfall (1993-2023) for a total of six weather stations within the Region. These selected stations not only meet the 30-year record of service requirement, but accurately represent the average monthly rainfall amounts for each county. Tables 1-2 through 1-6 present monthly rainfall amounts by county, in inches based on these 31-year averages. From highest to lowest values, average annual rainfall by county is reported as follows:

- Real County = 27.6 in
  - Prade Ranch, TX – USC00417232 (1993-2023)
- Kerr County = 26.5 in
  - Harper 3 Ene, TX – USC00413954 (1993-2023)
- Edwards County = 20.7 in
  - Rocksprings, TX – USC00417706 (1993-2023)
- Val Verde County = 19.2 in
  - Del Rio International Airport, TX – USW00022010 (1993-2023)
- Kinney County = 16.2 in
  - Brackettville, TX – USC00411007 (1993-2019)
  - Brackettville 0.1 NE, TX – US1TXKY0003 (2020-2023)

According to the National Centers for Environmental Information (NCEI), most rainfall occurs between the months of May and October, as indicated by a graph of average monthly rainfall for selected stations (Figure 1-7). Rainfall during the spring and summer months is dominated by widely scattered thunderstorms. Because of the convective nature of thunderstorms, the amount of spring and summer precipitation in the Region increases with elevation.

Table 1-2. Edwards County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Rocksprings, TX USC00417706	1993	0.67	0.86	1.12	2.46	2.40	0.93	0.21	0.55	2.57	0.25	0.15	0.74	
	1994	1.32	0.21	1.84	0.90	5.81	2.58	1.36	3.20	3.61	2.81	n/a	4.07	
	1995	0.24	0.71	2.60	0.90	5.06	0.92	1.31	0.72	3.53	0.38	2.26	0.29	
	1996	0.00	0.26	0.18	1.36	1.15	0.50	0.14	2.70	4.66	8.80	2.75	2.78	
	1997	1.00	3.12	3.10	3.36	3.47	7.19	0.01	0.69	3.80	2.97	0.83	0.97	
	1998	1.77	1.23	2.53	0.00	1.67	2.50	0.00	13.12	2.15	2.93	3.63	0.73	
	1999	0.12	0.11	3.14	2.14	5.10	3.16	2.73	0.35	0.29	3.04	0.00	0.12	
	2000	0.22	0.54	0.57	1.97	3.12	5.03	0.62	0.23	3.76	14.50	7.00	1.36	
	2001	2.06	1.04	1.41	1.28	3.07	1.21	0.48	2.06	0.43	1.49	3.37	0.78	
	2002	1.17	0.30	0.53	1.42	0.74	0.00	n/a	n/a	n/a	n/a	n/a	n/a	
	2003	0.03	0.55	1.41	0.04	0.23	4.20	4.61	2.47	5.03	3.73	1.30	0.01	
	2004	1.40	1.43	3.58	5.73	2.89	6.56	1.47	4.55	5.00	3.26	6.94	0.54	
	2005	1.31	3.15	3.83	0.65	5.27	0.61	3.98	3.42	0.08	4.27	0.02	0.12	
	2006	0.34	0.39	1.00	0.82	1.60	2.58	0.12	3.57	2.47	4.07	0.04	0.82	
	2007	3.23	0.11	5.23	2.33	7.61	8.70	5.45	5.96	4.43	0.60	1.19	0.34	
	2008	0.14	0.29	2.10	1.68	0.73	0.76	1.59	2.68	1.67	0.56	0.02	0.05	
	2009	0.10	0.05	2.07	2.63	1.31	0.71	3.85	0.69	1.97	2.63	1.17	1.93	
	2010	3.20	2.30	1.72	3.79	4.87	0.32	3.35	2.28	2.64	0.17	0.00	0.22	
	2011	1.31	0.78	0.00	0.48	0.43	0.13	0.24	0.42	2.46	2.48	n/a	0.01	
	2012	0.00	0.00	n/a	1.74	1.74	0.00	n/a	n/a	n/a	n/a	0.41	0.14	
	2013	2.11	n/a	0.75	0.59	2.70	3.19	n/a	n/a	1.15	2.71	0.39	n/a	
	2014	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.62	0.27	
	2015	1.18	0.11	0.31	1.93	4.84	0.46	0.00	0.06	0.09	0.02	0.00	1.67	
	2016	0.35	0.49	2.55	2.42	4.53	0.98	1.32	1.94	8.26	0.01	1.61	1.48	
	2017	0.61	1.47	0.95	3.75	1.23	0.02	0.52	n/a	n/a	n/a	n/a	n/a	
	2018	0.03	2.91	0.16	0.58	2.66	0.02	1.56	2.77	5.90	16.75	0.03	2.02	
	2019	0.07	0.06	1.56	2.44	2.02	7.74	0.05	2.39	0.66	1.16	0.71	0.35	
	2020	1.45	0.54	4.17	0.75	1.74	1.36	1.66	0.90	5.64	0.27	0.10	1.44	
	2021	0.70	1.50	0.95	0.88	3.88	1.95	4.32	2.96	2.12	0.75	0.45	0.13	
	2022	0.11	0.16	0.00	0.00	1.62	0.82	1.86	4.39	0.62	1.25	1.97	0.07	
	2023	0.16	0.02	0.85	0.23	4.20	0.55	0.54	0.63	1.51	5.32	1.37	1.29	
Total Average Monthly Rainfall		**0.85**	**0.80**	**1.62**	**1.59**	**2.83**	**2.12**	**1.40**	**2.12**	**2.47**	**2.81**	**1.27**	**0.80**	**20.67**

Note: N/A represents no data was recorded.

Table 1-3. Kerr County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Harper 3 Ene, TX - USC00413954	1993	1.59	1.32	1.66	2.65	1.98	1.85	0.00	0.00	2.33	1.96	0.45	1.24	
	1994	1.52	0.98	2.18	1.52	4.46	2.82	0.20	1.80	6.21	3.44	2.87	3.06	
	1995	0.44	0.72	2.97	2.74	7.05	2.66	1.09	0.88	6.71	0.65	1.34	0.54	
	1996	0.00	0.00	1.14	0.72	2.23	0.57	0.87	1.89	5.81	8.43	3.64	1.66	
	1997	1.35	8.91	4.70	5.94	2.68	10.05	0.84	1.41	0.69	2.61	1.06	2.68	
	1998	1.49	2.89	0.80	0.48	1.94	2.58	0.35	7.27	2.16	4.52	3.42	1.00	
	1999	0.05	0.00	5.49	1.82	5.03	4.04	2.63	0.00	0.28	2.20	0.02	0.81	
	2000	0.73	1.96	1.58	1.45	5.76	3.89	0.31	0.12	3.01	4.59	7.44	1.14	
	2001	2.34	1.58	2.93	0.85	2.65	0.96	1.07	3.57	2.54	2.10	8.62	1.43	
	2002	1.03	0.72	1.70	1.93	1.12	2.69	10.66	0.87	1.27	5.39	1.04	1.80	
	2003	0.51	1.64	1.65	0.07	1.53	5.19	2.17	3.74	4.59	4.78	0.81	0.08	
	2004	1.82	2.41	2.60	3.95	1.78	13.66	1.28	2.49	1.27	2.14	4.31	0.66	
	2005	1.98	3.24	4.22	n/a	n/a	n/a	n/a	n/a	0.00	1.52	0.75	0.00	
	2006	1.14	0.73	1.43	4.68	5.10	1.49	1.86	1.14	4.44	3.20	0.02	1.01	
	2007	2.94	0.06	6.24	2.23	11.43	5.99	5.12	6.08	4.12	0.47	0.82	0.15	
	2008	0.20	0.18	1.37	1.59	2.40	0.75	1.33	2.72	0.34	0.74	0.07	0.23	
	2009	0.32	0.13	3.68	3.25	1.41	0.42	1.40	1.78	5.86	4.69	2.07	1.25	
	2010	4.30	2.40	3.45	5.21	2.06	1.29	4.04	0.00	5.16	0.13	0.17	0.33	
	2011	0.98	0.61	0.00	0.31	0.96	0.20	0.30	0.12	0.81	0.80	1.24	3.60	
	2012	2.07	2.71	5.11	0.05	5.03	1.09	1.06	0.60	5.22	0.75	0.06	0.34	
	2013	3.86	1.01	0.82	1.24	5.44	1.38	1.94	0.55	7.90	3.59	1.72	0.74	
	2014	0.00	0.10	0.09	0.75	6.34	2.06	1.17	1.84	3.19	2.36	1.99	0.60	
	2015	2.88	0.11	3.67	1.68	7.59	2.75	0.77	1.20	0.18	5.52	4.66	1.10	
	2016	0.00	1.11	3.77	3.66	5.50	1.33	0.88	3.57	1.91	1.02	3.55	0.10	
	2017	1.34	3.56	1.28	1.55	2.18	3.91	1.94	3.25	2.79	0.22	0.65	2.21	
	2018	0.10	2.13	0.51	0.72	3.34	0.81	1.51	1.61	9.80	9.54	1.00	3.56	
	2019	0.98	0.24	1.34	3.27	7.28	2.30	0.57	3.22	0.36	1.83	1.50	0.26	
	2020	2.12	1.38	6.38	4.17	8.22	2.16	0.48	0.67	3.29	0.38	n/a	1.06	
	2021	2.10	1.86	0.80	1.11	4.87	2.78	2.71	2.78	0.65	4.57	1.40	0.60	
	2022	0.57	0.68	0.24	1.83	0.98	0.77	0.94	5.96	1.05	1.09	2.67	0.34	
	2023	0.51	0.39	1.03	2.50	4.41	1.93	0.08	0.19	2.63	n/a	n/a	4.35	
Total Average Monthly Rainfall		**1.33**	**1.48**	**2.41**	**2.06**	**3.96**	**2.72**	**1.60**	**1.98**	**3.12**	**2.75**	**1.91**	**1.22**	**26.54**

Note: N/A represents no data was recorded.

Table 1-4. Kinney County Monthly Rainfall (1993-2023)
(inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Brackettville, TX - USC00411007	1993	0.00	0.10	0.46	1.64	n/a	0.63	0.33	0.30	1.14	0.12	0.12	0.13	
	1994	n/a	0.43	2.18	4.06	3.35	0.50	2.94	0.24	6.00	2.26	0.63	0.52	
	1995	0.00	0.86	n/a	0.60	4.79	2.76	0.00	3.67	6.48	0.13	3.39	0.27	
	1996	0.00	0.78	0.24	0.50	3.55	0.00	1.62	3.10	3.52	6.11	1.92	0.90	
	1997	0.80	2.28	3.00	2.93	2.62	5.68	1.12	0.15	3.14	1.76	2.78	0.84	
	1998	0.59	0.41	1.53	0.00	0.00	3.00	0.00	11.56	2.15	3.28	1.31	0.33	
	1999	0.12	0.00	3.32	0.91	2.85	7.34	2.38	0.85	0.85	1.53	0.00	0.00	
	2000	0.10	1.10	0.98	0.60	n/a	n/a	0.09	0.25	3.67	8.59	4.11	0.41	
	2001	1.10	0.62	2.16	0.25	4.74	1.01	0.73	3.82	1.91	1.60	2.83	0.00	
	2002	0.00	0.00	1.35	1.46	0.58	2.15	4.80	0.00	1.53	n/a	n/a	n/a	
	2003	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
	2004	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
	2005	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
	2006	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.14	
	2007	2.09	0.03	5.16	0.52	6.56	6.35	17.22	0.56	2.50	1.95	0.90	0.83	
	2008	0.00	0.20	0.54	n/a	2.69	n/a	n/a	n/a	0.82	0.70	0.00	0.10	
	2009	0.40	0.00	2.67	0.95	1.50	0.70	n/a	n/a	n/a	n/a	n/a	n/a	
	2010	n/a	3.04	0.77	2.64	4.89	3.72	2.53	2.51	2.08	0.00	0.05	0.02	
	2011	0.13	0.16	0.02	0.68	0.74	0.11	1.25	0.17	0.73	0.72	0.03	1.28	
	2012	0.57	0.58	2.08	0.94	5.09	0.00	2.50	1.44	2.99	0.07	0.25	0.11	
	2013	1.18	0.01	0.20	0.41	3.26	10.05	0.30	0.61	5.56	2.55	0.92	0.41	
	2014	0.01	0.31	0.11	0.28	2.46	10.06	2.80	2.85	0.29	0.43	0.00	0.71	
	2015	1.50	0.45	3.21	4.15	8.28	1.70	0.30	1.60	0.19	4.54	0.28	0.00	
	2016	1.24	1.20	1.84	2.20	5.57	0.00	0.00	10.30	8.30	0.00	1.92	3.68	
	2017	0.95	3.93	0.75	3.00	3.44	1.79	0.00	0.50	2.00	0.00	0.00	1.79	
	2018	0.00	0.13	0.00	0.95	0.60	0.00	n/a	n/a	7.93	n/a	1.20	1.85	
	2019	n/a	n/a	0.18	2.13	n/a	n/a	n/a	n/a	0.63	n/a	n/a	n/a	
Brackettville 0.1 NE, TX - US1TXKY0003	2020	1.32	0.18	2.20	5.03	2.00	2.09	0.00	0.60	4.16	0.29	0.44	1.12	
	2021	0.98	1.04	0.42	2.19	1.19	1.74	1.85	1.86	0.99	2.45	0.29	0.26	
	2022	n/a	0.32	n/a	0.29	3.70	0.04	1.00	8.69	0.90	2.28	0.98	0.05	
	2023	0.23	n/a	1.38	0.25	3.29	0.35	0.45	1.59	0.74	0.46	0.31	n/a	
Total Average Monthly Rainfall		**0.43**	**0.59**	**1.19**	**1.28**	**2.51**	**1.99**	**1.43**	**1.85**	**2.30**	**1.35**	**0.80**	**0.54**	**16.23**

Note: N/A represents no data was recorded.

Table 1-5. Real County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Prade Ranch, TX - USC00417232	1993	1.18	1.63	1.38	2.18	2.10	2.40	0.00	0.00	4.19	1.05	0.32	1.48	
	1994	2.14	1.20	5.22	1.67	5.92	5.23	1.96	1.14	1.74	2.41	2.60	3.17	
	1995	0.32	0.24	2.12	1.85	2.11	4.37	0.41	1.97	7.52	0.44	3.21	0.05	
	1996	0.00	0.06	0.85	1.61	4.68	1.05	0.99	3.58	5.97	8.98	2.97	0.82	
	1997	1.07	4.80	3.61	3.36	3.68	12.28	0.21	0.15	1.23	4.57	1.13	0.75	
	1998	3.08	1.80	2.92	0.00	1.60	2.37	0.00	14.17	2.28	2.39	3.84	0.58	
	1999	0.60	0.00	3.53	3.72	3.74	3.77	2.08	0.00	0.00	1.36	0.00	0.70	
	2000	0.20	1.62	0.42	0.73	4.00	5.20	0.18	0.52	1.93	12.17	8.30	0.30	
	2001	2.45	1.23	2.39	2.77	3.85	0.27	0.00	4.16	3.70	0.90	10.18	2.40	
	2002	0.00	0.97	1.08	2.98	3.56	1.39	6.26	0.32	2.35	7.95	0.90	2.57	
	2003	0.35	2.00	1.10	0.00	1.22	3.70	2.80	2.60	6.08	4.03	2.44	0.35	
	2004	1.49	0.62	4.16	8.36	1.05	12.66	0.30	1.74	2.86	2.48	7.25	1.15	
	2005	1.40	1.78	1.84	0.77	3.71	1.20	3.05	2.07	0.00	3.83	0.70	0.00	
	2006	0.53	0.60	0.65	1.35	1.75	2.72	2.53	0.73	6.96	4.03	0.00	0.78	
	2007	2.38	0.00	6.59	2.20	7.03	9.17	6.01	2.54	5.40	0.70	0.90	0.68	
	2008	0.19	0.00	0.73	0.55	1.33	0.00	1.69	1.27	2.09	0.75	0.00	0.25	
	2009	0.25	0.27	2.95	3.20	2.57	0.00	0.74	0.20	4.15	2.35	0.84	1.18	
	2010	3.34	4.20	1.81	4.15	3.04	0.47	3.89	1.14	3.24	0.00	0.00	1.36	
	2011	0.72	0.52	0.00	0.30	1.15	0.35	1.41	1.09	2.12	1.80	1.92	2.65	
	2012	1.12	3.46	1.40	1.33	6.86	0.15	1.95	0.97	4.47	0.10	0.40	0.00	
	2013	2.30	0.02	0.35	1.80	7.01	2.82	2.42	0.77	3.80	4.57	1.85	0.78	
	2014	0.00	1.20	0.10	0.00	5.70	4.09	1.66	2.80	3.25	0.72	2.74	0.55	
	2015	1.68	0.29	2.96	2.95	11.59	4.78	0.00	0.92	0.00	7.98	4.05	1.67	
	2016	1.27	1.10	2.82	1.90	7.86	3.25	0.48	5.95	7.68	0.05	1.05	2.25	
	2017	1.05	3.00	1.96	2.75	3.85	2.52	0.20	2.61	4.75	0.60	0.15	4.04	
	2018	0.50	1.52	0.67	1.45	1.74	0.00	2.80	4.60	10.25	14.44	0.45	3.60	
	2019	0.00	0.45	2.03	2.90	2.80	3.52	0.55	1.48	0.10	1.24	1.6	0.00	
	2020	2.80	1.90	4.59	3.15	3.64	0.81	1.68	3.59	3.83	0.40	n/a	1.60	
	2021	2.92	1.77	0.80	1.12	6.62	6.58	1.31	2.48	1.85	1.71	0.66	0.23	
	2022	0.25	0.37	0.09	1.02	1.83	0.20	1.19	5.00	1.42	1.69	2.74	0.17	
	2023	0.73	0.30	0.58	1.25	7.34	2.16	0.81	1.09	2.04	4.42	1.55	1.54	
Total Average Monthly Rainfall		**1.17**	**1.26**	**1.99**	**2.04**	**4.03**	**3.21**	**1.60**	**2.31**	**3.46**	**3.23**	**2.09**	**1.21**	**27.60**

Note: N/A represents no data was recorded.

Table 1-6. Val Verde County Monthly Rainfall (1993-2023) (inches)

Station Name	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Annual Rainfall
Del Rio International Airport, TX - USW00022010	1993	0.60	0.77	0.47	0.72	1.29	5.28	0.97	2.54	0.77	0.68	0.13	0.18	
	1994	2.36	1.61	2.49	1.74	2.61	0.05	5.07	0.57	1.24	1.70	0.39	3.14	
	1995	0.03	0.31	1.06	0.75	7.33	0.16	0.08	1.11	3.06	2.13	1.24	0.49	
	1996	0.00	0.39	0.02	0.62	1.20	0.02	0.07	4.77	2.09	0.88	0.87	0.34	
	1997	0.20	2.01	2.77	2.55	5.66	3.70	0.77	0.23	1.41	2.39	0.77	0.55	
	1998	0.01	0.34	1.06	0.01	0.08	1.35	0.00	20.93	1.43	1.46	1.94	0.24	
	1999	0.01	0.01	1.89	3.17	0.29	5.61	1.48	2.42	0.00	0.39	0.00	0.01	
	2000	0.03	0.94	0.28	0.90	1.03	4.38	0.65	0.11	1.32	5.00	2.82	0.51	
	2001	1.08	0.54	0.90	0.22	1.33	0.00	0.13	0.35	2.24	0.43	1.12	0.35	
	2002	0.01	0.02	0.10	1.44	1.81	3.09	0.87	0.63	1.28	7.39	0.73	0.31	
	2003	0.32	0.43	0.68	0.09	6.90	1.01	5.34	0.92	3.36	4.47	0.37	0.04	
	2004	0.81	0.74	3.48	3.34	2.39	2.28	1.79	2.48	3.96	4.57	4.71	0.40	
	2005	0.90	1.38	1.74	0.09	2.49	0.10	3.73	1.69	0.02	8.72	0.00	0.06	
	2006	0.25	0.04	0.16	0.59	1.83	2.07	0.01	1.36	2.38	0.53	0.01	0.36	
	2007	2.22	0.03	2.36	1.93	7.93	4.61	4.72	1.25	3.49	0.76	1.18	0.32	
	2008	0.08	0.02	0.57	0.06	0.58	2.73	0.97	11.32	0.28	0.16	0.00	0.41	
	2009	0.03	0.00	1.52	1.86	0.46	3.06	0.17	0.06	3.37	0.65	0.71	1.01	
	2010	2.52	1.54	1.16	6.03	10.45	0.71	4.72	0.57	2.06	0.01	0.01	0.00	
	2011	0.08	0.15	0.04	0.01	1.07	0.45	0.37	4.49	1.14	0.39	0.75	0.98	
	2012	0.48	1.20	1.31	1.20	4.49	0.01	1.00	0.11	3.90	0.06	0.05	0.04	
	2013	1.33	0.00	0.06	0.36	1.47	1.76	2.77	0.74	4.44	1.40	0.66	0.48	
	2014	0.00	0.22	0.32	0.08	0.73	4.69	0.35	0.78	4.23	1.24	3.26	0.25	
	2015	0.77	0.22	2.21	1.71	10.17	3.48	0.04	2.02	0.50	5.79	0.56	0.34	
	2016	0.68	0.07	2.08	4.16	1.62	2.93	0.05	10.26	5.92	0.11	2.11	2.48	
	2017	0.19	0.78	0.51	5.64	3.97	2.46	0.66	1.68	6.33	0.43	0.03	1.74	
	2018	0.00	0.19	0.13	0.01	1.23	0.59	2.15	4.11	7.75	8.73	0.06	1.26	
	2019	0.14	0.11	0.41	1.24	3.51	7.85	0.00	0.00	0.10	0.86	0.55	0.05	
	2020	0.67	0.28	3.09	1.41	1.21	0.44	0.45	0.50	3.17	0.17	0.02	1.26	
	2021	0.33	0.35	0.21	1.12	4.03	2.00	2.27	2.87	0.32	1.98	0.64	0.26	
	2022	0.02	0.14	0.00	0.64	1.93	0.24	0.00	7.57	2.45	2.38	0.62	0.00	
	2023	0.14	0.07	1.85	1.18	5.02	0.10	1.66	1.84	0.08	1.77	0.74	0.62	
Total Average Monthly Rainfall		**0.53**	**0.48**	**1.13**	**1.45**	**3.10**	**2.17**	**1.40**	**2.91**	**2.39**	**2.18**	**0.87**	**0.60**	**19.20**

Note: N/A represents no data was recorded.

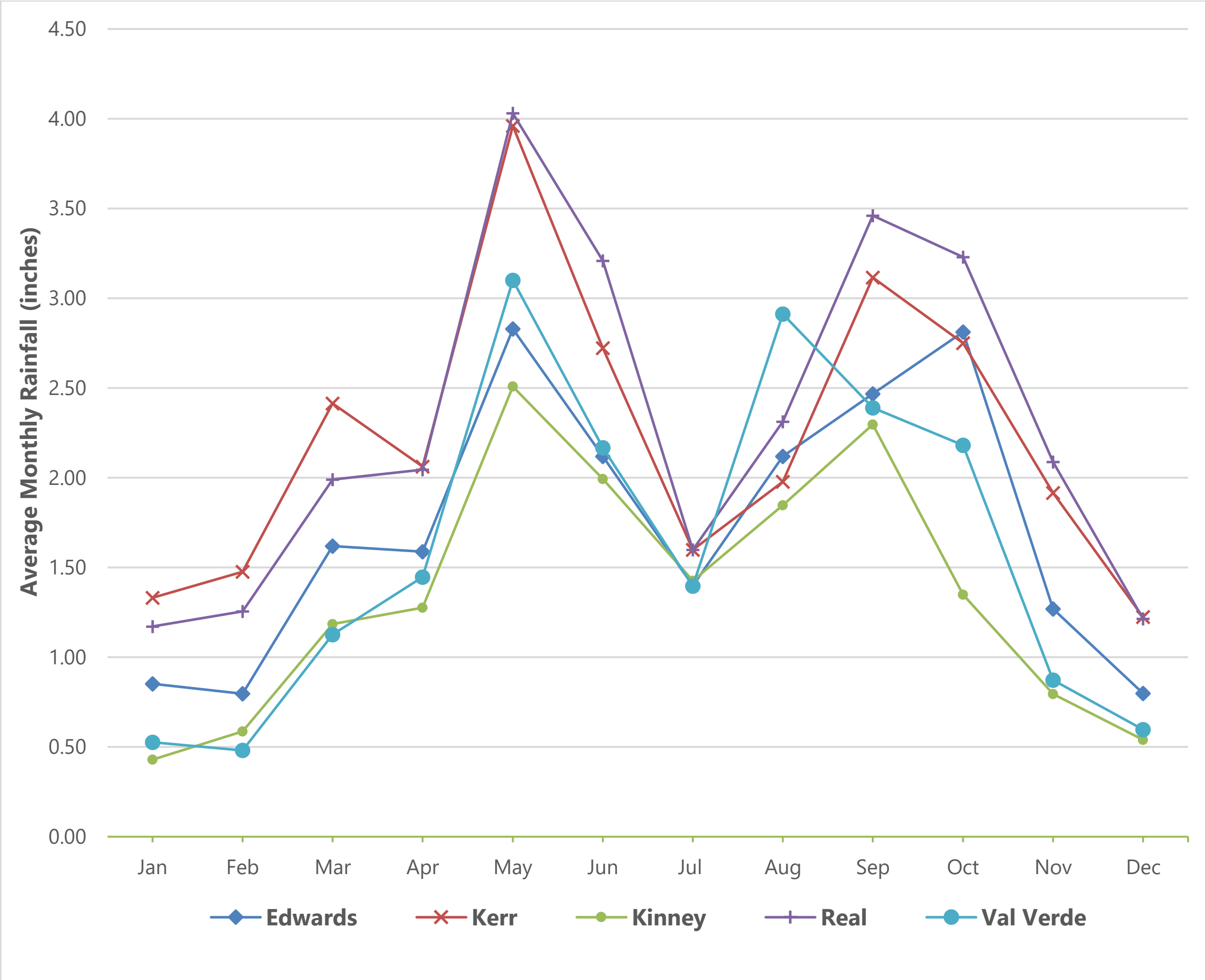

Figure 1-7. Average Monthly Rainfall for Selected Stations
Source: NCEI

Drought conditions are assumed in the planning process to ensure that adequate infrastructure and planning is in place under severe water shortage conditions. Drought in the Plateau Region is discussed in detail in Chapter 7 of this *Plan*. Drought in the Plateau Region can be defined in the following operational definitions:

Meteorologic drought is an interval of time, usually over a period of months or years, during which precipitation cumulatively falls short of the expected supply.

Agricultural drought is that condition when rainfall and soil moisture are insufficient to support the healthy growth of crops and to prevent extreme crop stress. It may also be defined as a deficiency in the amount of precipitation required to support livestock and other farming or ranching operations.

Hydrologic drought is a long-term condition of abnormally dry weather that ultimately leads to the depletion of surface water and groundwater supplies, the drying up of lakes and reservoirs, and the reduction or cessation of spring flow or streamflow.

Comparing the 1950s Drought of Record (DOR) and the current drought can be accomplished by using historic precipitation, stream flow records, spring discharges and water level measurements in wells for locations that have accumulated data measurements since the 1940s, which is discussed further in Chapter 7 Section 7.2. For this planning cycle, the drought of the 1950s is declared the DOR. However, it is the intent of the current *2026 Plan*, to illustrate in Chapter 7 that although the 1950s drought is the Historic DOR, current drought conditions are of major significance. Current preparation for drought in the Plateau planning region is presented in detail in Chapter 7. Existing GCD and water utility drought management plans and actions are recognized, drought monitoring triggers and actions are recommended (Table 7-8), and emergency response options are discussed.

1.2.6 Native Vegetation and Ecology

A biotic province is a considerable and continuous geographic area that is characterized by the occurrence of one or more ecologic associations that differ, at least in proportional area covered, from the associations of adjacent provinces. In general, biotic provinces are characterized by peculiarities of vegetation type, ecological climax, flora, fauna, climate, physiography and soil. Most of the Plateau Region has been classified as belonging to the "Balconian" Biotic Province, but small portions of Val Verde and Kinney Counties also lie within the "Tamaulipan" and "Chihuahuan" Biotic Provinces (Figure 1-8). In the 1800s, the area was predominantly savannas of tall native grasses with occasional stands of Live Oak and Spanish Oak. While Live Oak and Spanish Oak are still prevalent in many areas, most of the Region has become blanketed by Ashe Juniper (commonly referred to as "Mountain Cedar") largely because of the suppression of prairie fires in the last century. Another infestation of tree species found in the area is that of Mesquite. Infestation of trees may reduce the quantity and quality of water from watersheds, as well as reduce the diversity of plant species beneath the trees' canopies.

Cypress trees line the banks of many of the rivers and are known to reduce flows in the streams during their active season. Along with the Live Oak, Spanish Oak and Cypress, other species of trees that are generally found are Post Oak, Elm, Hackberry, Cottonwood, Sycamore and Willow. Native grass species include Little and Big Bluestem, Indian Grass, Sideoat Grama and Texas Winter Grass. Some of the introduced species of grass include Coastal Bermuda, Plains Lovegrass, Klein Grass and King Ranch Bluestem. In the western portion of the Region, a varying growth of prickly pear, other cactus species, sage, and other brushy species predominate.

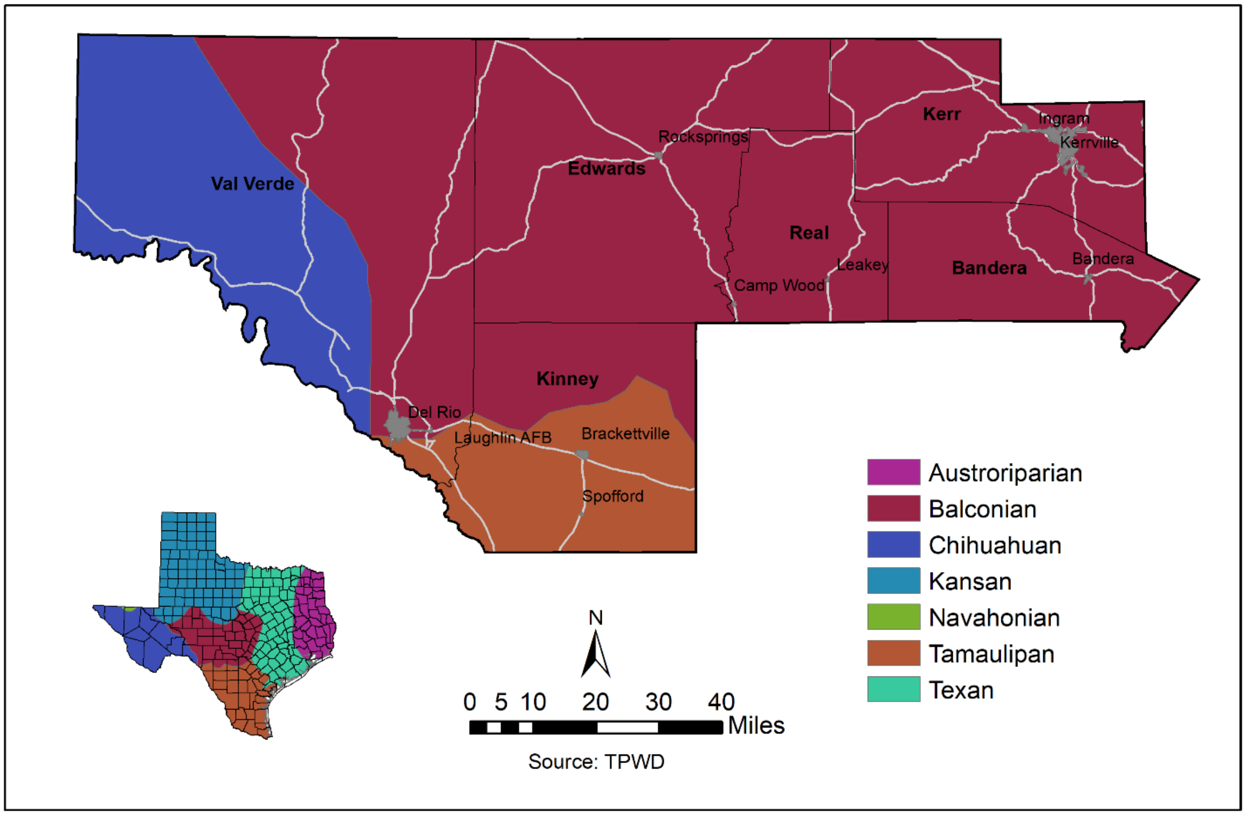

Figure 1-8. Biotic Provinces

1.2.7 Vegetative Management and Land Stewardship

The PWPG strongly believes that the concept of properly managing rural lands is essential in maintaining natural spring flows in the headwaters of surface streams and rivers. Several invasive species have been recognized in the Plateau Region, as well as elsewhere in the State, that have a negative impact on surface water flow in springs, creeks and rivers, as well as recharge to underlying aquifers. Species of major concern are Giant River Cane (Arundo donax) and Elephant Ears (Colocasia esculenta) in watersheds, and the encroachment of woody species such as Ashe Juniper and Mesquite.

Vegetative management of Ashe Juniper, also commonly known as "cedar" has become a significant source of discussion and debate as to its impact on water resources on the Edwards Plateau. Cedar is native to central Texas and was initially controlled through both man-made and natural fires and through foraging. As these events were reduced, cedar returned and has been expanding in the Region. Eradication methods have included controlled burns, use of heavy equipment to pull the plant up by its roots, mechanical cutting and chemical methods. There has been a great deal of debate regarding the impact on water resources by cedar with various groups calculating how much water cedar takes away from both groundwater and surface water sources. In a 2003, report done by A.A. McCole of the University of Texas Geology Department, it was noted that "in late summer and winter the Ashe Juniper (cedar) obtains approximately between 72% and 100% of its water from groundwater. In contrast, during the wet periods of the year, spring and fall, mass balance calculations indicate that between 45% and 100% of Ashe Juniper's water is derived from soil water. This seasonal shift indicates the presence of Ashe Juniper can appreciably reduce groundwater resources both by lateral roots intercepting potential recharge during the wet season and direct uptake of groundwater by deep roots during the dry season. Ashe Juniper will directly compete with grasses for soil water during the wet season, limiting herbaceous productivity."

In 2010, the USGS published a study, "Effects of Brush Management on the Hydrologic Budget and Water Quality In and Adjacent to Honey Creek State Park Natural Area, Comal County, Texas 2001-2010". The results of this study indicated that brush eradication did not increase runoff to streams but did suggest that clearing brush can result in more infiltration. The study found that before clearing potential groundwater recharge was 17% of the total water budget but increased to 24% after clearing. The study showed that prior to clearing a rainfall event produced a potential recharge of 5.91 inches of the rain that fell and after clearing, it increased to 7.09 inches; for a difference of 1.18 inches. In terms of actual water, the extra 1.18 inches amounts to approximately 32,042 gallons per acre. Thus, to obtain one-acre foot of water, 10 acres will need to be cleared to gain an additional acre foot of water as infiltration. From these and other studies, brush eradication can have a positive impact on groundwater recharge and a limited impact on surface water runoff. However, with increased groundwater recharge it is reasonable to assume that a portion of this groundwater would percolate down to aquifers as well as provide base flow to surface water via springs.

Vegetative management of Giant River Cane (Arundo donax) has become a significant problem throughout the Plateau Region. The problems with the Arundo donax are a direct result of its incredible growth potential. Individual shoots can grow upwards of four inches per day and a mature stand can be approximately 30 feet tall. To support these high growth rates the plant requires significant amounts of water. When compared to native species, Arundo donax requires three times as much water minimum. USDA scientists have calculated that each acre of Arundo donax requires approximately 4.37-acre feet of water to support proper growth. Thus, 1,000 acres of Arundo donax will consume approximately 4,370-acre feet of water per year.

The eradication methods identified to control the Arundo donax are mechanical, chemical and biological. Additionally, any combination of these three treatment protocols can be an effective treatment option. Mechanical control involves removing all portions of the living plant. Due to the plant's high silicon count, the plant is very flammable and highly susceptible to burning. This approach is not recommended as the burning does not affect the root structure.

Chemical control has proven to be the most effective, which uses glyphosate. Glyphosate interferes with the plants' synthesis of nutrients. Biologic control seems to hold promise for eradication. The USDA has been experimenting with using the asexual Arundo Wasp and has received permits to use this wasp in the eradication efforts. Due to the Arundo donax being highly invasive, the Texas Legislature passed legislation making it illegal to sell or distribute Arundo donax without a permit from the Texas Department of Agriculture.

Vegetative management and land stewardship are potentially feasible water management strategies under regional water planning guidelines. However, in order to meet rule requirements, the recommended strategies would need to be able to document a firm yield under drought-of-record conditions. In previous plans, the TWDB has argued that during a drought-of-record, the additional runoff or recharge attained from vegetative management strategies are not sustained during a prolonged drought, and thus the supply benefit under these conditions will be zero. However, the PWPG strongly feels that drought mitigation measures such as vegetative management is an effective water conservation practice that can reduce water scarcity and improve soil moisture, which reduces the impact of drought.

1.2.8 Agricultural and Natural Resources

Agricultural resources in the Region include beef cattle, sheep, goat, and exotic game animals. Apple and pecan orchards, along with hay, are grown in the eastern part of the Region. Kinney County, with its extensive irrigated lands in the western half of the county, accounts for twice the amount of water used for irrigation as the rest of the Region combined.

The natural resources of the Region include both terrestrial and aquatic habitats that boast some of the best scenic drives and vistas, river rafting, and hunting and fishing in Texas. Natural resources also include the great diversity of plant and animal wildlife that inhabit these environments. Texas Parks and Wildlife Department maintains a comprehensive source of information on State and Federally listed rare, threatened, and endangered plants and animals, and Species of Greatest Conservation need (last updated January 31, 2024) (http://www.tpwd.state.tx.us/huntwild/wild/wildlife_diversity/nongame/listed-species).

Understandably, both local residents and tourists make use of these resources in their enjoyment of numerous public parks, dude ranches, resorts, recreational vehicle parks, and camping facilities. The following protected sites located within the Plateau Region depend upon adequate water to supply both environmental and recreational needs:

- Lost Maples State Natural area
- Hill Country State Natural Area
- Devil's River State Natural Area
- Seminole Canyon State Historic Park
- Dolan Falls Ranch Preserve (Nature Conservancy)
- Devils Sinkhole State Natural Area
- Kickapoo Cavern State Park
- Kerrville-Schreiner Park
- Heart of the Hills Fisheries Science Center
- Amistad National Recreation Area
- Love Creek Preserve
- Bandera Canyonlands

Both agricultural and natural resources water-supply needs are directly influenced by the quantity and quality of water available primarily in rivers and tributaries that flow through the Region and to a lesser extent on impounded lakes, ponds and tanks. Except for the Rio Grande, much of the drainage basins for the headwater of local rivers lie within Plateau Region counties. Spring flow emanating from bedrock aquifers, particularly the Edwards-Trinity (Plateau) Aquifer, create the base flow of these streams. As such, these headwater watershed areas are particularly susceptible to drought conditions as the water table naturally drops and spring flow diminishes.

Agricultural activities in the Region that rely on surface water are designed to accommodate the intermittent nature of the supply. In most cases, this means that agricultural water-supply needs will be supplemented by groundwater sources, or that irrigation activities will cease until river supplies are replenished. Both plant and animal species endemic to this Region have developed a tolerance for the intermittent nature of surface water availability; however, significantly long drought conditions can have a severe effect on these species. Riparian water needs for birding habitat is particularly critical.

Of recognized importance to the water planning process is the concern of the impact that future development of water supplies might have on preexisting conditions in the Region. Water-supply management strategies developed in Chapter 5 of this *Plan* include an evaluation of each strategy's impact on agricultural, natural resources, and environmental concerns (see Tables 5-2 and 5-4, and Appendix 5B).

The principle potential impact to agriculture is the possible change in water rights use from agricultural use to municipal use of Guadalupe River flows in Kerr County. As these strategies only potentially change the use of the water and not the volume of diversion, there is no anticipated significant impact to natural resources.

1.2.9 Upper Llano River Watershed Protection Plan

"The Upper Llano River, which includes the North and South Llano Rivers, is a true gem of the Texas Hill Country. Due to the pristine nature and relatively constant flow of its springs, the Upper Llano is currently a healthy ecosystem supporting a variety of aquatic and terrestrial communities and numerous recreational opportunities" (Upper Llano River Watershed Protection Plan Brochure). As part of the Healthy Watersheds Initiative under the Clean Water Act, the Upper Llano River Watershed Plan was published and implemented in 2016. The South Llano River Watershed contains portions of Edward, Kerr, and Real Counties, all within the Plateau Region planning area. Voluntary implementation efforts will focus on the following conservation measures:

- Repair and replace septic systems
- Decrease the feral hog population by 66 percent
- Increase the number of ranches with wildlife management plans by at least two annually, particularly in riparian areas
- Enroll more than 250,000 acres of ranchlands in conservation plans
- Treat more than 144,000 acres of brush to improve range conditions and increase water supply
- Begin restoration on 14 miles of areas lacking a riparian buffer and begin to improve vegetation conditions along 10 percent of the riparian zone
- Identify and implement best management practices to address urban runoff
- Improve water use efficiency by 10 percent

1.2.10 Water Supply Source Vulnerability/Security

Following the events of September 11th, 2001, Congress passed the Bio-Terrorism Preparedness and Response Act. Drinking water utilities serving more than 3,300 people were required to have completed vulnerability preparedness assessments and response plans for their water, wastewater, and stormwater facilities. The U.S. Environmental Protection Agency (EPA) funded the development of three voluntary guidance documents, which provide practical advice on improving security in new and existing facilities of all sizes. The documents include:

Interim Voluntary Security Guidance for Water Utilities
https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=60000RF8.txt

Interim Voluntary Security Guidance for Wastewater/Stormwater Utilities
https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=60000S18.txt

Interim Voluntary Guidelines for Designing an Online Contaminant Monitoring System
https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=60000RLO.txt

1.2.11 Supply Source Protection

According to the 1996 Safe Drinking Water Act Amendments, the Texas Commission on Environmental Quality (TCEQ) is required to assess every public drinking water source for susceptibility to certain chemical constituents. The Source Water Protection Program (SWPP) is a voluntary program designed to help public water systems identify and implement measures that will protect their sources of water from potential contamination. Assessment reports are provided to the public water systems and are often used to implement local source water protection projects. Table 1-6 lists Plateau Region public water systems involved in the TCEQ's SWPP 2014-2023).

Table 1-6. Plateau Region Source Water Protection Participants

PWS Name	County	Report Date
Latigo Ranch Subdivision	Bandera	2023
City of Bandera	Bandera	2020
City of Rocksprings	Edwards	2016
Center Point Taylor System	Kerr	2014

1.3 REGIONAL WATER DEMAND

1.3.1 Major Demand Categories

Total estimated year 2030 water consumptive use in the Plateau Region is 50,980 acre-feet. The largest category of demand is municipal and county-other (32,738 acre-feet), followed by irrigation (15,238 acre-feet), livestock (2,655 acre-feet), mining (312 acre-feet), and manufacturing (37 acre-feet). Municipal, county-other and irrigation combined represent 94 percent of all water use in the Region (Figure 1-9). Current and projected water demand for all water-use types are discussed in detail in Chapter 2.

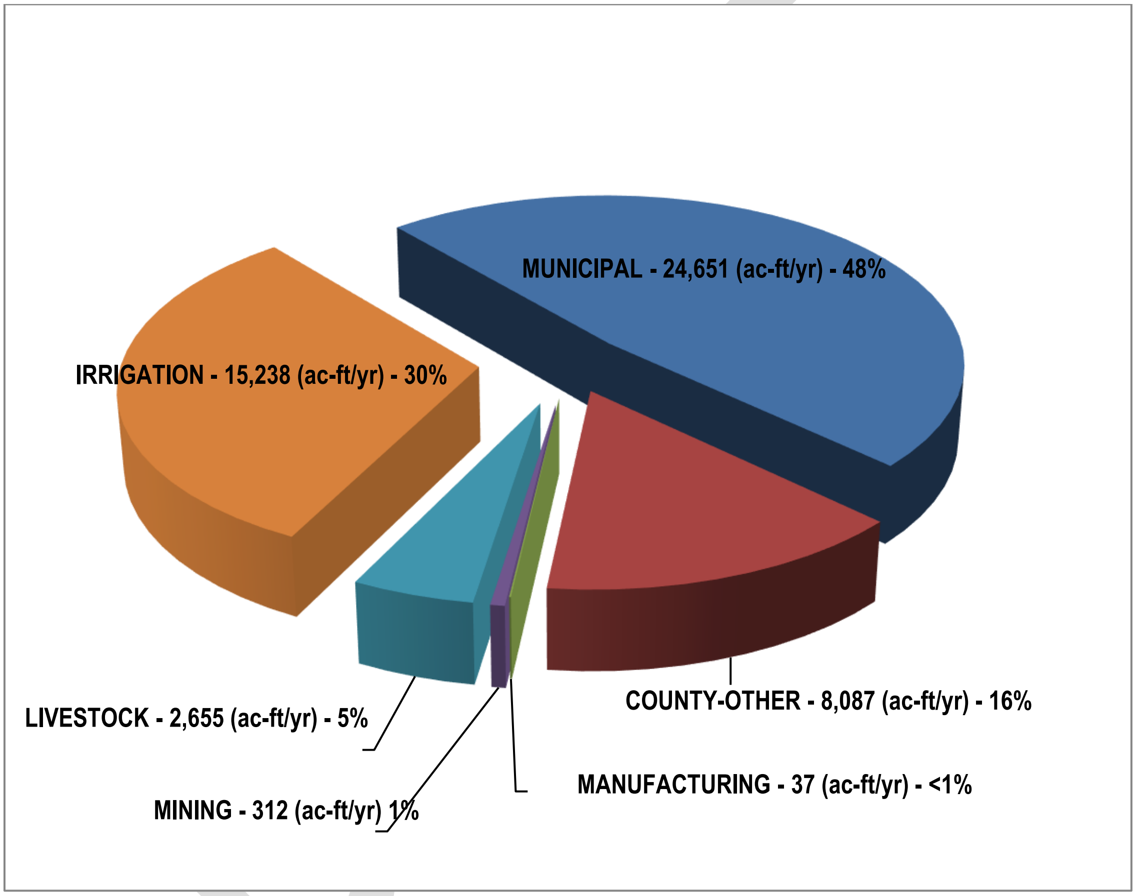

Figure 1-9. Year 2030 Projected Water Demand by Water-Use Category

1.3.2 Municipal

Municipal demand consists of both residential and commercial water uses. Commercial water consumption includes business establishments, public offices, and institutions, but does not include industrial water use. Residential and commercial uses are categorized together because they are similar types of uses, i.e.: they both use water primarily for drinking, cleaning, sanitation, air conditioning, and landscape watering.

The largest center of municipal demand is served by Del Rio Utilities in Val Verde County, where 12,977 acre-feet of water is estimated to be used in 2030 to supply residents and businesses. Forty one percent of regional municipal water is used in Val Verde County, and 29 percent is used in Kerr County.

Del Rio Utilities is the only entity in the Plateau Region that is designated as a Major Water Provider (MWP). In addition to its own use, the City provides water to Laughlin Air Force Base and subdivisions outside of the City. The City also provides water and wastewater services to two colonias, Cienegas Terrace and Val Verde Park Estates.

1.3.3 Agriculture and Ranching

Agriculture and ranching water demand consist of all water used by the agricultural industry to support the cultivation of crops and the watering of livestock and wildlife. Where groundwater is the source of irrigation water, the TWDB defines irrigation use as “on farm demand.” Where surface water is the source of irrigation water, the TWDB defines irrigation use as both “on farm” demand and “diversion loss.” Surface water is typically conveyed by an open canal system, which exposes the water supply to possible loss from seepage, breaks, evaporation, and uptake by riparian vegetation. In the year 2030, irrigation is projected to represent the second greatest water use in the Region (15,238 acre-feet) with Kinney County accounting for 44 percent of the regional total. Livestock use in the Region amounted to 2,655 acre-feet.

1.3.4 Manufacturing and Mining

Manufacturing (and industrial) demand consists of all water used in the production of goods for domestic and foreign markets. Some processes require direct consumption of water as part of the manufacturing process. Others require very little water consumption but may require large volumes of water for cooling or cleaning purposes. In some manner or another, water is passed through the manufacturing facility and used either as a component of the product or as a transporter of waste heat and materials. Within the Plateau Region, manufacturing is accounted for in Kerr, Real and Val Verde Counties.

Mining demand consists of all water used in the production and processing of nonfuel (e.g., sulfur, clay, gypsum, lime, salt, stone and aggregate) and fuel (e.g., oil, gas, and coal) natural resources by the mining industry. In all instances, water is required in the mining of minerals either for processing, leaching to extract certain ores, controlling dust at the plant site, or for reclamation. This also includes the production of crude petroleum and natural gas. Water used in the mining industry in the Plateau Region is principally reported in Bandera, Edwards, Kerr, and Val Verde Counties.

1.3.5 Environmental and Recreational Water Needs

Environmental and recreational water use in the Plateau Region is recognized as being an important consideration as it relates to the natural community in which the residents of this Region share and appreciate. In addition, for rural counties, tourism activities based on natural resources offer perhaps the best hope for modest economic growth to areas that have seen a long decline in traditional economic activities such as agriculture.

A goal of this *Plan* is to provide for the health, safety, and welfare of the human community, with as little detrimental effect to the environment as possible. To accomplish this goal, the evaluation of strategies to meet future water needs (Chapter 5) includes a distinct consideration of the impact that each implemented strategy might have on the environment.

Recreation activities involving human interaction with the outdoor environment are often directly dependent on water resources. It is recognized that the maintenance of the regional environmental community's water-supply needs serves to enhance the lives of citizens of the Plateau Region as well as the tens of thousands of annual visitors to this Region. Environmental and recreational water needs are further discussed throughout the *Plan* and especially in Chapters 2, 3, and 8.

1.4 WATER SUPPLY SOURCES

Water-supply sources in the Plateau Region include groundwater primarily from six aquifers and surface water from five river basins. Reuse of existing supplies is also considered a water-supply source. A more detailed description of these sources and estimates of their supply availability are provided in Chapter 3.

1.4.1 Groundwater

Within the Plateau Region, the TWDB recognizes three major aquifers: The Trinity, the Edwards-Trinity (Plateau), and the Edwards (Balcones Fault Zone). For this *Plan*, the Austin Chalk Aquifer in Kinney County, the Frio and Nueces River Alluvium Aquifers in Real and Edwards Counties, and the Ellenburger-San Saba Aquifer in Kerr County have also been identified as groundwater sources (Figure 1-10). Groundwater Conservation Districts in Bandera, Kerr, Kinney, Real and Edwards Counties provide for local management control of their groundwater resources.

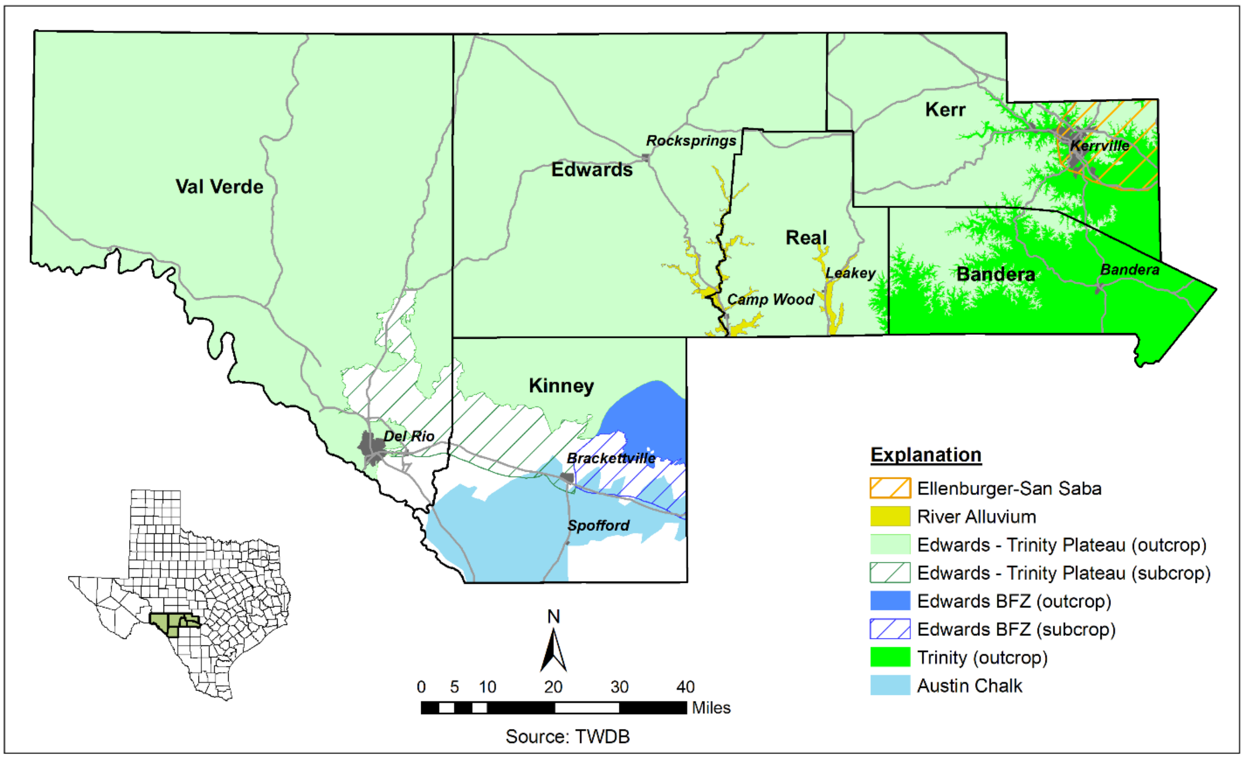

Figure 1-10. Groundwater Sources

1.4.1.1 Trinity Aquifer

The Trinity Aquifer occurs in its entirety in a band from the Red River in North Texas to the Hill Country of south-central Texas and provides water in all or parts of 55 counties. Trinity Group formations also occur as far west as the Panhandle and Trans-Pecos regions where they are included as part of the Edwards-Trinity (High Plains) and Edwards-Trinity (Plateau) Aquifers. The Trinity Aquifer in south-central Texas has been further subdivided into:

- Upper Trinity Aquifer
    - Upper Glen Rose Limestone
- Middle Trinity Aquifer
    - Lower Glen Rose Limestone
    - Hensell Sand / Bexar Shale
    - Cow Creek Limestone
- Lower Trinity Aquifer
    - Sligo Limestone / Hosston Formation

1.4.1.2 Edwards-Trinity (Plateau) Aquifer

Rock formations of the Edwards-Trinity (Plateau) Aquifer form the Edwards Plateau east of the Pecos River, and in its entirety, provide water to all or parts of 38 counties. The Aquifer extends from the Hill Country of Central Texas to the Trans-Pecos region of West Texas. The Aquifer consists of saturated sediments of lower Cretaceous age Trinity Group formations and overlying limestones and dolomites of the Edwards Group. The Glen Rose limestone is the primary unit in the Trinity in the southern part of the Plateau. Springs issuing from the Aquifer form the headwaters of several eastward and southerly flowing rivers. Some of the largest springs of the area are in Val Verde and Kinney Counties, such as San Felipe Springs near Del Rio and Los Moras Springs in Brackettville.

1.4.1.3 Edwards (BFZ) Aquifer

The Edwards (Balcones Fault Zone (BFZ)) Aquifer in its entirety covers approximately 4,350 mi² in parts of 11 counties. It forms a narrow belt extending from a groundwater divide in Kinney County through the San Antonio area northeastward to the Leon River in Bell County. Within the Plateau Region, water in the Aquifer generally moves from the recharge zone toward natural spring discharge points such as Las Moras Springs near Brackettville or southeasterly underground toward San Antonio.

1.4.1.4 Austin Chalk Aquifer

The Austin Chalk Aquifer occurs in the southern half of Kinney County and in the southernmost extent of Val Verde County. Most Austin Chalk wells discharge only enough water for domestic or livestock use; however, primarily in the area along Las Moras Creek, a few wells are large enough to support irrigation.

1.4.1.5 Nueces River Alluvium Aquifer

The Nueces River Alluvium occurs along the boundary between Edwards and Real Counties. Extending over an area of approximately 24,450 acres, the alluvial aquifer contains approximately 3,574 acre-feet of annually available water. The Community of Barksdale, local subdivisions, and other rural domestic homes derive their water supply from this Aquifer.

1.4.1.6 Frio River Alluvium Aquifer

The Frio River Alluvium in central Real County extends over an area of approximately 9,530 acres and contains approximately 2,145 acre-feet of annually available water. Water supplies for the Community of Leakey, several subdivisions, and other rural domestic homes are derived from this small Aquifer.

1.4.1.7 Ellenburger-San Saba Aquifer

The Ellenburger-San Saba Aquifer was added to the previous plan as a new source. During this cycle of regional water planning, there was a test hole exploration, pumping test results, and water chemistry analysis which verified that this Aquifer does provide a potential source of water that can meet the supply needs of northeastern Kerr County. In 2023, the City of Kerrville assumed ownership of the new Ellenburger production well, which produced approximately 89 acre-feet. The Headwaters GCD has authorized rules for future permitting of this resource.

1.4.1.8 Other Aquifers

Located along many of the streams and rivers throughout most of the Region are shallow alluvial floodplain deposits mostly composed of gravels and sands eroded from surrounding limestone hills. Wells completed in these deposits supply small to moderate quantities of water mostly for domestic and livestock purposes.

1.4.2 Surface Water

The Plateau Region is unique within all planning regions in that it straddles five river basins rather than generally following a single river basin or a large part of a single river basin (Figure 1-11). From west to east, included within the Region are the Rio Grande, Nueces, Colorado, Guadalupe, and San Antonio River Basins. The headwaters of rivers that form the Nueces, Guadalupe, and San Antonio River Basins originate within this Region, and the headwaters of the South Llano River, a major tributary to the Colorado River, also occur here.

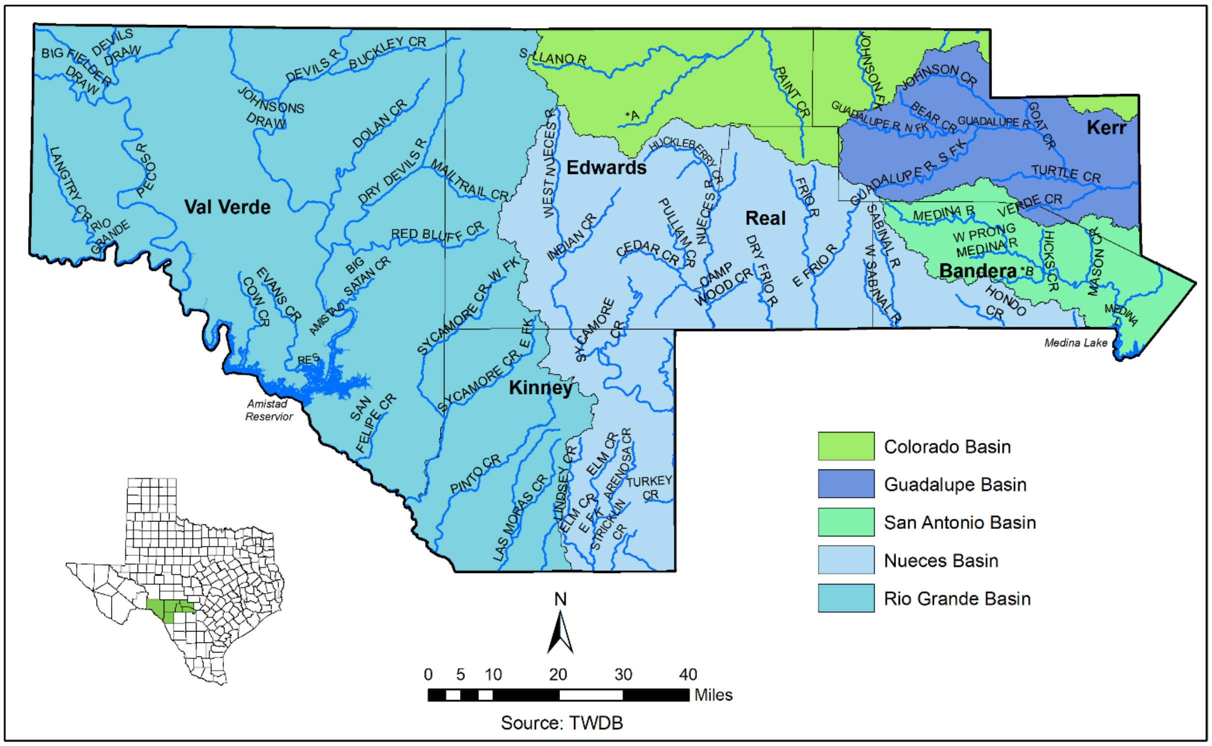

Figure 1-11. Surface Water Sources

1.4.2.1 Rio Grande Basin

The Rio Grande, or Rio Bravo as it is known in Mexico, forms the border between the United States and Mexico. International treaties governing the ownership and distribution of water in the Rio Grande are discussed in Chapter 3. The 3.4 million-acre-feet International Amistad Reservoir is located on the Rio Grande in Val Verde County. Within the Plateau Region, the Pecos and Devil's Rivers in Val Verde County are the primary tributaries to the Rio Grande. Numerous springs, including San Felipe, Goodenough, and Las Moras, issue from the Edwards Aquifer and flow into tributaries of the Rio Grande. The mainstream of the Rio Grande does not provide water for municipal use in the Plateau Region and only provides limited amounts for irrigation use, primarily from a tributary, San Felipe Creek.

1.4.2.2 Nueces River Basin

The main stem of the Nueces River forms a portion of the border between Edwards and Real Counties. Tributaries of the Nueces River located in the Plateau Region include the Sabinal River and Hondo Creek in Bandera County, the West Nueces River in Edwards and Kinney Counties, and the Frio, East Frio, Dry Frio Rivers in Real County, and other minor tributaries.

1.4.2.3 Colorado River Basin

The City of Rocksprings in Edwards County straddles the drainage divide between the Nueces River Basin and the Colorado River Basin. The portion of Edwards County north of Rocksprings, small northern portions of Real County and the northwestern part of Kerr County drain to the Llano River watershed in the Colorado River Basin. The South Llano River, part of the headwaters of the Llano/Colorado, begins in Edwards County.

1.4.2.4 Guadalupe River Basin

Most of Kerr County lies in the Guadalupe River Basin. The Guadalupe River is not only an important water-supply source for Kerrville and other communities in Kerr County, but is also a major tourist attraction for the area. Although Kerrville and the Upper Guadalupe River Authority own water rights, much of the flow of the Guadalupe is permitted for downstream use.

1.4.2.5 San Antonio River Basin

Bandera County is mostly split between the Nueces and San Antonio River Basins. The Medina River flows through Bandera County and drains to the San Antonio River. Medina Lake straddles the boundary between Bandera, Medina and Bexar Counties and serves as a major irrigation source for land downstream in Medina County. This reservoir has a conservation storage capacity of 254,823 acre-feet. In the spring 2015 the reservoir was only 3.5 percent full; however, as of March 2019 the reservoir had recovered to full capacity. Since 2019, the reservoir has not reached 100 percent full conservation storage capacity, and as of July 2024 it remains at 3.6 percent full. The firm yield of Medina Lake and its associated Diversion Lake is zero.

1.4.3 Springs and Wildlife Habitat

Springs have played an important role in the development of the Plateau Region. They were important sources of water for Native American Indians, as indicated by the artifacts and petroglyphs found in the vicinity of many of the springs. These springs were also principle sources of water for early settlers and ranchers. Although springs are often recognized by a given name, in reality most springs are complexes of numerous openings through which groundwater flows to the surface. Additional discussion pertaining to springs and their function in the relationship between groundwater and surface water is contained in Chapter 3.

The PWPG has identified three “Major Springs” that are important for their municipal water supply (Figure 1-12). The fourth largest spring in Texas, San Felipe Springs, discharges to San Felipe Creek east of Del Rio and provides municipal drinking water for Del Rio, as well as irrigation use downstream. Las Moras Springs in Kinney County is of historical significance for its importance as a supply source on early travel routes and military fortifications. Today, Las Moras Springs supports the Fort Clark community and is hydrologically associated with the same aquifer system that serves Fort Clark MUD and the City of Brackettville. The third major spring is Old Faithful in Real County, which is the drinking water-supply source for the City of Camp Wood. While still the major contributor to the City of Camp Wood's water supply, it is no longer the sole source as the City has drilled a deep well (Trinity aquifer) that supplements the spring especially during drought conditions.

Although only three springs are identified as "Major Springs", the PWPG recognizes that all springs in the Region are important and are deserving of natural resource protection. The PWPG also recognizes the important ecological water-supply function that all springs perform in the Region. Springs create and maintain base flow to rivers, contribute to the esthetic and recreational value of land, and are significant sources of water for wild game and aquatic species. Water issuing from springs forms wetlands that attract migratory birds and other fowl throughout the year. The wetlands host numerous terrestrial and aquatic species, some of which are listed as threatened or endangered.

Two supplemental study reports were prepared in 2005 for the PWPG that address springs (Table 1-1). The first report considers the location and geohydrology of springs in Kinney and Val Verde Counties, and the second report relates spring flow in western Kerr County to base flow in the three branches of the upper Guadalupe River.

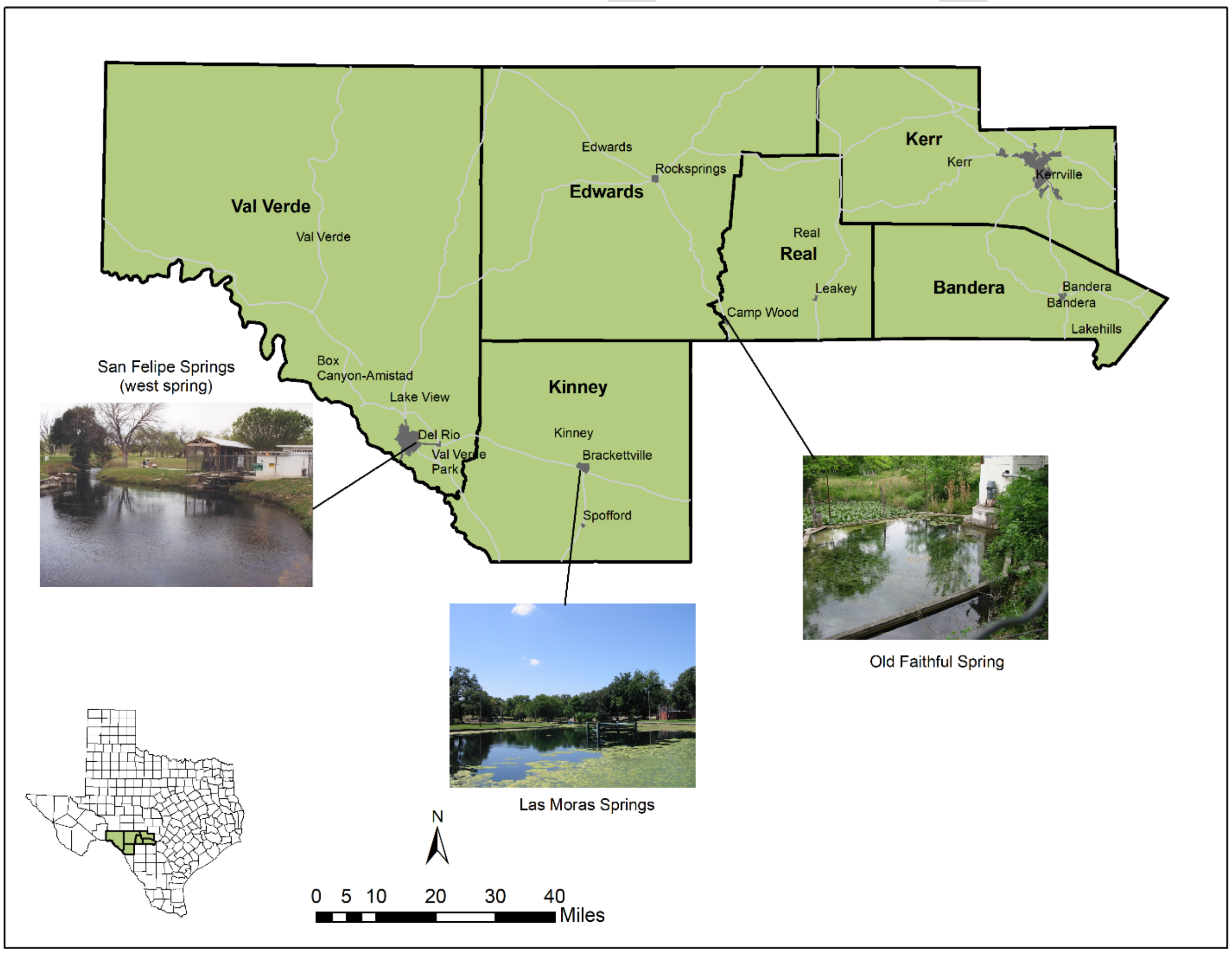

Figure 1-12. Major Springs

1.4.4 Reuse

Water recycling, or reuse, is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation or industrial processes. The Cities of Kerrville, and Bandera have active water reuse programs. Del Rio Utilities in Val Verde County is planning on making reuse a future supply, all of which is described in Chapter 3.

1.4.5 Water Quality Issues

Water quality is generally good throughout the Plateau Region; however, a few specific water quality issues should be mentioned. Increasing population impacts water quality in many ways, one of which is the increase in urban runoff that comes with the increase in impervious cover in populated areas. Impervious cover concentrates runoff into storm sewers and drains, which then discharges into streams, increasing the flow, which also increases the erosional power of the water. In addition, urbanization also causes increased pollutant loads, including sediment, oil/grease/toxic chemicals from motor vehicles, pesticides/herbicides/fertilizers from gardens and lawns, viruses/bacteria/ nutrients from human and animal wastes including septic systems, and heavy metals from a variety of sources.

Increasing population has also manifested itself in the fragmentation of larger properties. With the advent of fragmentation comes the proliferation of new wells being drilled to serve the individual properties. Each new well thus becomes another potential conduit for surface contamination to reach the underlying aquifer system.

From a regional perspective, groundwater quality is relatively good. However, the constituent of most concern is nitrate, which is found above the primary maximum contaminant level in a number of water sample analyses from the Edwards (BFZ) Aquifer and the Austin Chalk Aquifer in Kinney County.

Historically, the primary contribution to poor groundwater quality occurs in wells that do not have adequately cemented casing. Improperly completed wells allow poorer quality water to migrate into zones containing good quality water. Poorer groundwater quality in the Region is generally from two different sources, evaporite beds in the Glen Rose formation and from surface contamination, both of which can be prevented by proper well construction. Also, of concern are above normal levels of radioactivity that have been detected in sand sequences of the Glen Rose and Hensell formations in some areas.

1.5 COLONIAS

Disadvantaged political subdivisions, often referred to as "colonias," represent a special subset of municipal demand in the Region, and a challenge to water suppliers. Most colonias are subdivisions in unincorporated areas located along the United States/Mexico international border and typically consist of small land parcels sold to citizens of low-income. These subdivisions often lack basic services such as potable water, sewage disposal and treatment, paved roads, and proper drainage. Public health problems are often associated with these colonias.

The Economically Distressed Area Program (EDAP) was created by the Texas Legislature in 1989 and is administered by the TWDB. The intent of the program is to provide local governments with financial assistance for bringing water and wastewater services to disadvantaged political subdivisions, including cities, counties, water districts and non-profit water-supply corporations. An economically distressed area is defined as one in which water supply or wastewater systems are not adequate to meet minimal State standards, financial resources are inadequate to provide services to meet those needs, and there was an established residential subdivision on or prior to June 1, 2005. Affected counties are counties adjacent to the Texas/Mexico border, or that have per capita income 25 percent below the State median and unemployment rates 25 percent above the State average for the most recent three consecutive years for which statistics are available. Additional information pertaining to eligibility and requirements for this program are available on the TWDB web site: https://www.twdb.texas.gov/financial/programs/EDAP/index.asp.

In 2019, the 86th Texas Legislature made changes to the program with the passage of Senate Bill 2452, which directed the TWDB to develop a system for prioritizing EDAP projects and consider projects that will have a "substantial effect." This includes projects serving areas determined to have a nuisance dangerous to public health and safety resulting from water supply and sanitation problems and projects for applicant's subject to an enforcement action related to water supply or sewer service violations. EDAP projects in the Plateau Region are located in Kerr, Kinney, Real and Val Verde Counties (Table 1-7). There is a total of three active projects and six completed projects within the Region.

Data pertaining to all EDAP projects in the State can be accessed through the TWDB website: https://www.twdb.texas.gov/financial/programs/EDAP/index.asp.

Table 1-7. Economically Distressed Area Program Projects (August 31, 2023)

County	Sponsor	Project	EDAP Funding ($)	Other TWDB Funding ($)	Status
Kerr	Kerr County	Center Point Wastewater System	27,668,118.00	33,697,673.00	Active
	Upper Guadalupe RA	Center Point Water System	39,554.50		Completed
Kinney	Spofford	Brackettville Transmission Line	243,113.00		Completed
Real	Nueces River Authority	Leakey Wastewater System	20,251,979.20	9,961,460.00	Active
Val Verde	Val Verde County	Colonia Water Service	942,000.00		Active
	Val Verde County	Lakeview Estates Water & Wastewater	410,966.59		Completed
	Val Verde County	Water & Wastewater Planning	283,284.00		Completed
	Del Rio	Cienegas Terrace	3,245,986.00		Completed
	Del Rio	Val Verde Parke Estates	10,747,009.00		Completed

1.6 WATER LOSS AUDITS

Water is a precious and finite resource. Water loss control benefits utilities by conserving their water and diminishing their need for future acquisitions of additional water supply. Reducing water loss offers utilities the ability to increase their water-use efficiency, improve their financial status, and assist with long-term water sustainability.

In 2003, the 78th Texas Legislature, Regular Session, enacted House Bill 3338 to help conserve the State's water resources by reducing water loss occurring in the systems of drinking water utilities. This statute requires that all retail public utilities with more than 3,300 connections or a financial obligation to TWDB are required to submit a standardized water audit annually. All other retail public water suppliers are required to submit a water loss audit to TWDB every five years. The next five-year required submittal is due by May 1, 2026 for the 2025 audit year. However, it is strongly encouraged that all retail public water suppliers complete an audit annually to better track water loss and identify issues that need immediate addressing.

In response to the mandates of House Bill 3338, TWDB developed a water audit methodology for utilities that measures efficiency, encourages water accountability, quantifies water losses, and standardizes water loss reporting across the State. This standardized approach to auditing water loss provides utilities with a reliable means to analyze their water loss performance. Utilizing a methodology derived from the American Water Works Association (AWWA) and the International Water Association (IWA), the TWDB has published a manual that outlines the process of completing a water loss audit: "Water Loss Audit Manual for Texas Utilities" – TWDB Report 367 (2008), which can be viewed at http://www.twdb.texas.gov/publications/brochures/conservation/doc/WaterLossManual_2008.pdf.

Additionally, for the sixth cycle of regional water planning, the TWDB developed several helpful resource guides regarding water loss performance targets and water loss threshold values. These documents can be accessed here: https://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2026/conservationresources.asp.

Historically, the AWWA recommended that entities with more than 10 percent water loss take corrective action. However, water loss industry standards have changed from recommending a one-size-fits-all target for water loss, to recommending water loss key performance indicators of apparent loss per connection per day, real loss per connection per day, and/or real loss per mile per day. Uses and limitations of key performance indicators have been developed by the AWWA's Water Loss Control Committee in their AWWA Water Loss Control Committee Report (2020).

The TWDB is required to evaluate the water loss of retail public utilities that request financial assistance for a water-supply project using water loss thresholds as an indicator of whether a utility must include funds for mitigating water loss as part of their request for financial assistance. RWPGs must consider strategies to address any issues identified in the water loss audit information. In order to determine a water loss threshold, TWDB established benchmarking values detailed in the Conservation Resource Guide for Development of the 2026 Regional Water Plans, which uses six years of water loss audit data and finds the median for two distinct groups of utilities for real loss, which is defined as the physical leakage of water from the distribution system. The two distinct groups of utilities identified are as follows: (1) retail public utilities located in less dense communities (less than 32 connections per mile), for which the threshold or median is 57 gallons per connection per day, and (2) retail public utilities locating in more dense communities (32 or more connections per mile), for which the threshold or median is 30 gallons per connection per day. These water loss thresholds are not a target but are only used for determining whether a utility may need to mitigate their water loss.

Table 1-8 provides a listing of reported utility audits performed in the Plateau Region that meet the key performance indicators discussed above. More details regarding reported annual water loss audit data can be accessed here: https://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2026/conservationresources.asp.

Table 1-8. Plateau Region 2018-2022 Public Water System Real Water Loss Report for Utilities that Exceed Water Loss Performance Targets (gallons per year)

Public Water Supply (PWS) Name	Report Year	Service Connection on Density	Water Loss per Connection per Day	Corrected Input Volume	Reported Breaks Leaks	Unreported Loss	Total Real Losses	Cost of Real Losses ($)
Bridlegate Subdivision	2021	64.89	31.86	17,072,000	0	2,328,218	2,328,218	2,398
City of Bandera	2018	34.13	38.07	77,059,133	20,000	11,581,368	11,601,368	8,121
City of Kerrville	2018	61.32	46.07	1,455,155,670	175,953,360	28,481,337	204,434,697	516,811
	2019	58.52	35.69	1,218,044,330	1,994,705	147,943,583	149,938,288	61,475
	2020	39.13	68.54	1,274,814,433	2,635,793	241,042,576	243,678,369	102,345
	2022	51.23	31.00	1,346,347,475	84	135,707,279	135,707,363	56,997
City of Rocksprings	2020	50.67	56.76	71,958,333	50,000	11,117,019	11,167,019	33,501
	2021	61.90	51.12	62,110,309	80,000	10,187,759	10,267,759	30,803
Community Water Group WSC	2020	39.00	68.53	8,506,263	0	1,864,770	1,864,770	12,475
Del Rio Utilities Commission	2018	55.53	121.76	2,729,740,000	1,879,625	450,969,107	452,848,732	188,385
	2019	55.53	82.00	2,492,620,000	1,463,145	234,340,837	235,803,982	99,038
	2022	59.34	128.99	2,949,502,105	2,458,942	758,745,572	761,204,514	1,903,011
Flying L Ranch PUD	2019	34.00	48.52	19,946,842	227,442	3,569,625	3,797,067	835
Real WSC	2020	33.04	42.20	7,783,000	102,970	1,936,135	2,039,105	4,343
	2022	28.21	60.54	8,503,527	22,000	1,888,335	1,910,335	1,152
San Pedro Canyon Subdivision - Upper	2021	23.08	196.79	13,810,408	0	3,549,071	3,549,071	8,873
Tierra Del Lago	2018	22.11	226.58	3,855,300	0	1,497,027	1,497,027	599
	2019	22.11	247.55	4,018,100	0	1,657,385	1,657,385	663
	2021	22.11	355.12	4,796,000	125,000	2,356,817	2,481,817	993
	2022	23.16	368.63	5,020,800	122,200	2,719,394	2,841,594	1,137

1.7 STATE AND FEDERAL AGENCIES

1.7.1 Texas Water Development Board (TWDB)

The TWDB (http://www.twdb.texas.gov) is the State agency charged with Statewide water planning and administration of low-cost financial programs for the planning, design and construction of water supply, wastewater treatment, flood control and agricultural water conservation projects. The TWDB, especially the Water Supply Planning Division is at the center of the legislatively mandated regional water planning effort. The agency has been given the responsibility of directing the process in order to ensure consistency and to guarantee that all regions of the State submit plans in a timely manner.

1.7.2 Texas Commission on Environmental Quality (TCEQ)

The TCEQ (http://www.tceq.texas.gov) strives to protect the State's natural resources, consistent with a policy of sustainable economic development. TCEQ's goal is clean air, clean water, and the safe management of waste, with an emphasis on pollution prevention. The TCEQ is the major State agency with regulatory authority over State waters in Texas and administers water rights of the Lower Rio Grande through the office of the Watermaster. The TCEQ is also responsible for ensuring that all public drinking water systems are in compliance with the strict requirements of the State of Texas. TCEQ is involved with the TWDB in developing a State consensus water plan. Prior to permit approval, TCEQ is required to determine if projects are consistent with regional water plans.

1.7.3 Texas Parks and Wildlife Department (TPWD)

The TPWD (http://www.tpwd.state.tx.us) provides outdoor recreational opportunities by managing and protecting wildlife and wildlife habitat and acquiring and managing parklands and historic areas. The agency currently has six internal divisions: Wildlife, Coastal Fisheries, Inland Fisheries, Law Enforcement, State Parks, Infrastructure. TPWD is involved with the TWDB in developing a State consensus water plan. Specifically, the agency looks to see that statewide environmental water needs are included. A TPWD staff person is a non-voting member of the Plateau Water Planning Group and provides essential environmental expertise to the planning process.

1.7.4 Texas Department of Agriculture (TDA)

The TDA (http://www.texasagriculture.gov/Home.aspx) was established by the Texas Legislature in 1907. The TDA has marketing and regulatory responsibilities and administers more than 50 separate laws. The current duties of the Department include: (1) promoting agricultural products locally, national, and internationally (2) assisting in the development of the agribusiness in Texas; (3) regulating the sale, use and disposal of pesticides and herbicides; (4) controlling destructive plant pests and diseases; and (5) ensuring the accuracy of all weighing or measuring devices used in commercial transactions. The Department also collects and reports statistics on all activities related to the agricultural industry in Texas. A TDA staff person is a non-voting member of the Plateau Water Planning Group and provides essential agricultural expertise to the planning process.

1.7.5 Texas State Soil and Water Conservation Board (TSSWCB)

The TSSWCB (http:/www.tsswcb.texas.gov/) is charged with the overall responsibility for administering and coordinating the State's soil and water conservation program with the State's soil and water conservation districts. The agency is responsible for planning, implementing, and managing programs and practices for abating agricultural and forest nonpoint source pollution. Currently, the agricultural/ forest nonpoint source management program includes problem assessment, management program development and implementation, monitoring, education, and coordination.

1.7.6 South Texas Watermaster Program

The South Texas Watermaster Program is responsible for an area that encompasses 50 counties in south central Texas and manages water rights based on "run of the river rights." Individuals and groups are informed as needed concerning water rights and other matters related to availability of surface water. The water master program also updates and maintains water-right ownerships and assessments due to each water right account.

1.7.7 Public Utility Commission of Texas

The Public Utility Commission of Texas regulates the State's electric, telecommunication, and water and sewer utilities, implements respective legislation, and offers customer assistance in resolving consumer complaints.

1.7.8 International Boundary and Water Commission (IBWC) and Comisión Internacional de Límites y Aquas (CILA)

The IBWC (https://www.ibwc.gov/) and CILA provide binational solutions to issues that arise during the application of United States-Mexico treaties regarding boundary demarcation, national ownership of waters, sanitation, water quality, and flood control in the border region; the treaties are discussed in Chapter 3.

1.7.9 United States Geological Survey (USGS)

The USGS (https://www.usgs.gov/) serves the Nation by providing reliable scientific information to (1) describe and understand the Earth, (2) minimize loss of life and property from natural disasters, (3) manage water, biological, energy, and mineral resources, and (4) enhance and protect quality of life. The USGS's Water Resources Division has played a major role in the understanding of the groundwater resources of Texas. Scientists with the USGS have conducted regional studies of water availability and water quality. Many of these studies have been conducted in conjunction with the TWDB. These studies have provided much of the data for more recent investigations conducted by graduate students and faculty members of many Texas universities.

1.7.10 United States Environmental Protection Agency (EPA)

The mission of the EPA (https://www.epa.gov/) is to protect human health and the environment. Programs of the EPA are designed (1) to promote national efforts to reduce environmental risk, based on the best available scientific information, (2) ensure that Federal laws protecting human health and the environment are enforced fairly and effectively, (3) guarantee that all parts of society have access to accurate information sufficient to manage human health and environmental risks, and (4) guarantee that environmental protection contributes to making communities and ecosystems diverse, sustainable, and economically productive.

1.7.11 United States Fish and Wildlife Department (USFWS)

The USFWS (https://www.fws.gov/) enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores vital wildlife habitat, protects and recovers endangered species, and helps other governments with conservation efforts. It also administers a Federal aid program that distributes money for fish and wildlife restoration, hunter education, and related projects across the country. The USFWS has provided comments that are pertinent to wildlife water needs to draft planning documents.

1.7.12 Upper Guadalupe River Authority

The Upper Guadalupe River Authority (UGRA) (http://www.ugra.org/) was created as a conservation and reclamation district by the Texas Legislature in 1939. UGRA is a highly respected steward in managing the watershed and water resources of the Upper Guadalupe River benefiting both people and the environment. The mission of the UGRA is to conserve and reclaim surface water through the preservation and distribution of the water resources for future growth in order to maintain and enhance the quality of life for all Kerr County citizens.

1.7.13 Nueces River Authority

The Nueces River Authority (NRA) (https://nueces-ra.org/) was created in 1935 by special act of the 44th Texas Legislature. Under supervision of the Texas Commission on Environmental Quality, NRA has broad authority to preserve, protect, and develop surface water resources including flood control, irrigation, navigation, water supply, wastewater treatment, and water quality control. NRA may develop parks and recreational facilities, acquire and dispose of solid wastes, and issue bonds and receive grants and loans.

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